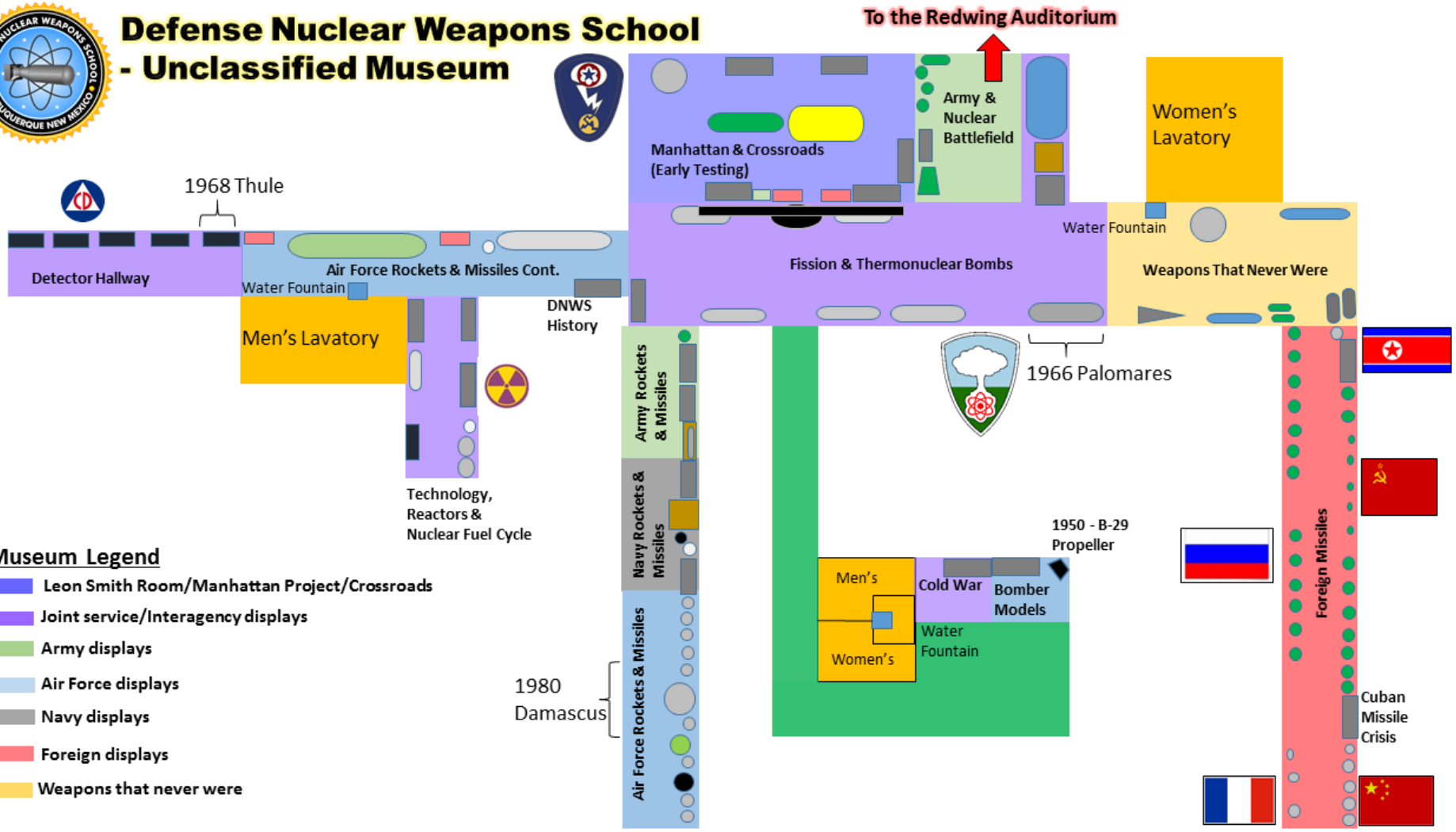
Los Alamos
NATIONAL LABORATORY
EST. 1943

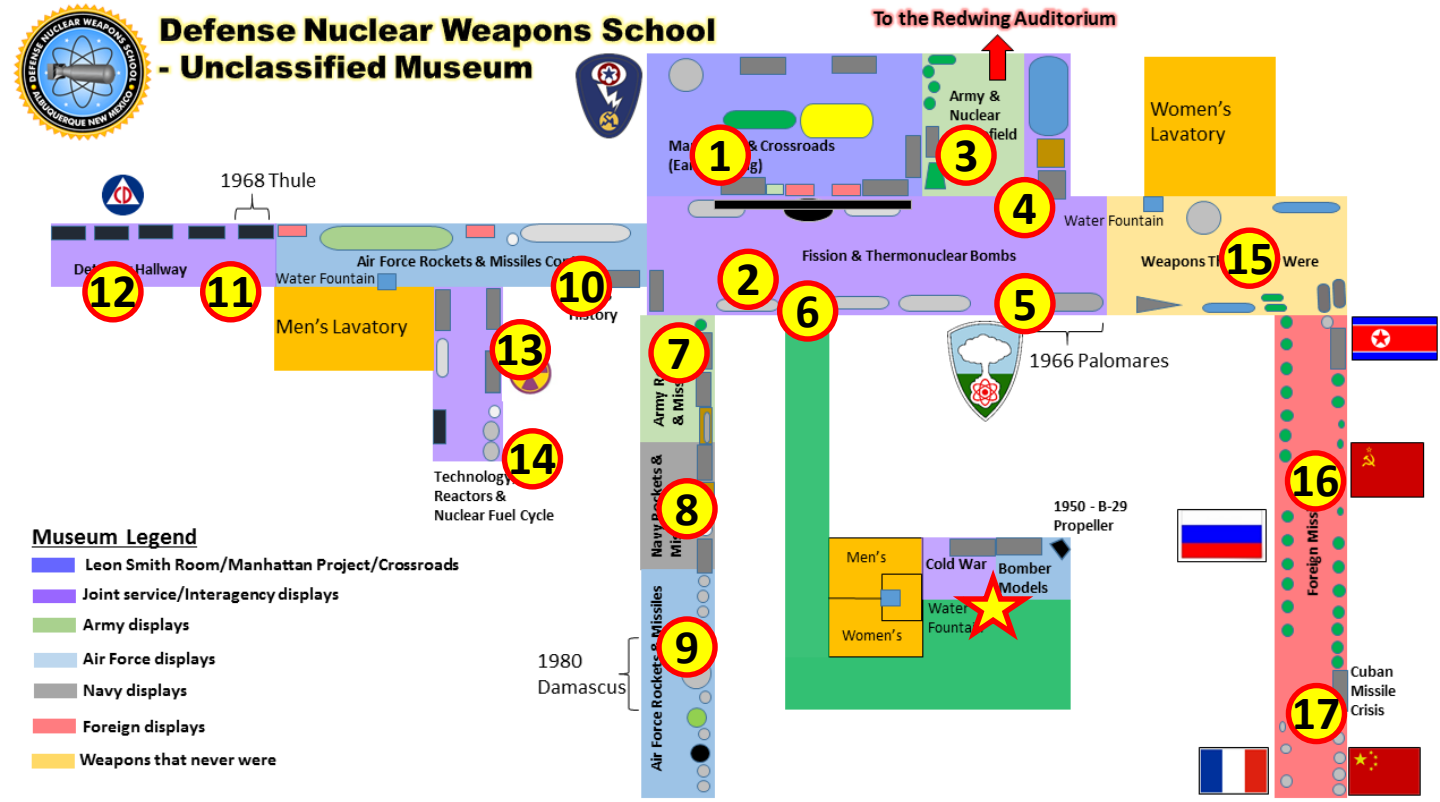
Y-12
National Security Complex

Defense Nuclear Weapons School - Unclassified Museum



The Correct Order for Unclassified Museum Tours

Defense Nuclear Weapons School - Unclassified Museum



The order for museum tours & grouped areas for posting static guides in museum sections.* *Full tours run 1.5 to 2 hours.*

★ **Begin in Lobby if at all Possible, B-29 Crash, bomber models and Cold War pop culture**

- **1**
  - 1 Leon Smith Room/Manhattan/Crossroads
- **2a**
  - 2 Fission Bombs
  - 3 Tactical, "Nuclear Battlefield" Displays
  - 4 Early Thermonuclear Bombs
- **2b**
  - 5 Thermonuclear Bombs Cont., Palomares
  - 6 Current Bombs
- **3a**
  - 7 U.S. Missiles & Rockets – Army
  - 8 U.S. Missiles & Rockets – Navy
- **3b**
  - 9 U.S. Missiles & Rockets – Air Force & Damascus
  - 10 U.S. Missiles & Rockets – Air Force Cont.
- **4**
  - 11 Civilian & Military Detectors, Thule
  - 12 Civil Defense & Dosimeters
- **5**
  - 13 National Labs & DOD Role in Technology
  - 14 Nuclear Fuel Cycle & Reactors
- **6**
  - 15 Weapons That Never Were
- **7**
  - 16 Foreign Missiles Hallway
  - 17 Cuban Missile Crisis

***Tour groups that stay together should not be larger than 15 per group. For a very large group or open house, at least 9 posted guides are needed to cover the entire hallway display area.**

The order for museum tours & grouped areas for posting static guides in museum sections.* *Full tours run 1.5 to 2 hours.*

Begin in Lobby if at all Possible, **B-29 Crash**, bomber models and Cold War pop culture

- **1** — 1 Leon Smith Room/Manhattan/Crossroads
- **2a** — 2 Fission Bombs; 3 Tactical, "Nuclear Battlefield" Displays; 4 Early Thermonuclear Bombs
- **2b** — 5 Thermonuclear Bombs Cont., **Palomares**; 6 Current Bombs
- **3a** — 7 U.S. Missiles & Rockets – Army; 8 U.S. Missiles & Rockets – Navy
- **3b** — 9 U.S. Missiles & Rockets – Air Force & **Damascus**; 10 U.S. Missiles & Rockets – Air Force Cont.
- **4** — 11 Civilian & Military Detectors, **Thule**; 12 Civil Defense & Dosimeters
- **5** — 13 National Labs & DOD Role in Technology; 14 Nuclear Fuel Cycle & Reactors
- **6** — 15 Weapons That Never Were
- **7** — 16 Foreign Missiles Hallway; 17 Cuban Missile Crisis

Key Learning Objectives for Each Area

- **B-29 crash**, early emphasis on safe designs and the school's role training accident responders in these types of accidents beginning in 1947-48.

1. The scale and complexity of the Manhattan Project and the need to bomb Japan.
   a. Introduce Leon Smith.
   b. Discuss early testing, Trinity & Crossroads
2. Military need of the Cold War drove designs smaller.
   a. Korean War drove TX-5 & TX-7 as well as the Grable test
   b. Nuclear depth bomb armed drone
   c. The U.S. decision to remove tactical (nuclear artillery) in 1991 was never reciprocated by the Russians
   d. Palomares accident
3. Examples of U.S. missiles and rockets, models not to any one scale, many engineering models.
   a. Missile technology and the missile race
   b. Operation Paperclip, V2 testing at WSMR and the Redstone putting the first man in space
   c. Damascus accident
4. DNWS has taught nuclear weapons accident response and radiological defense from its very beginnings in 1947.
   a. Thule accident and challenges of alpha contamination detection in arctic conditions
   b. Examples of military and civilian detector evolution and technologies
   c. DOD's role in Civil Defense
5. Importance of National Labs and DOD driving all of the technology we enjoy today & overview of nuclear materials and reactors.
6. Highlight weapons that never made it into the arsenal, usually because of the end of the Cold War.
7. All scale foreign missile delivery systems, while showcasing past systems highlights on going threat and need for deterrence.
   a. North Korea Missile Proliferation
   b. Cuban Missile Crisis

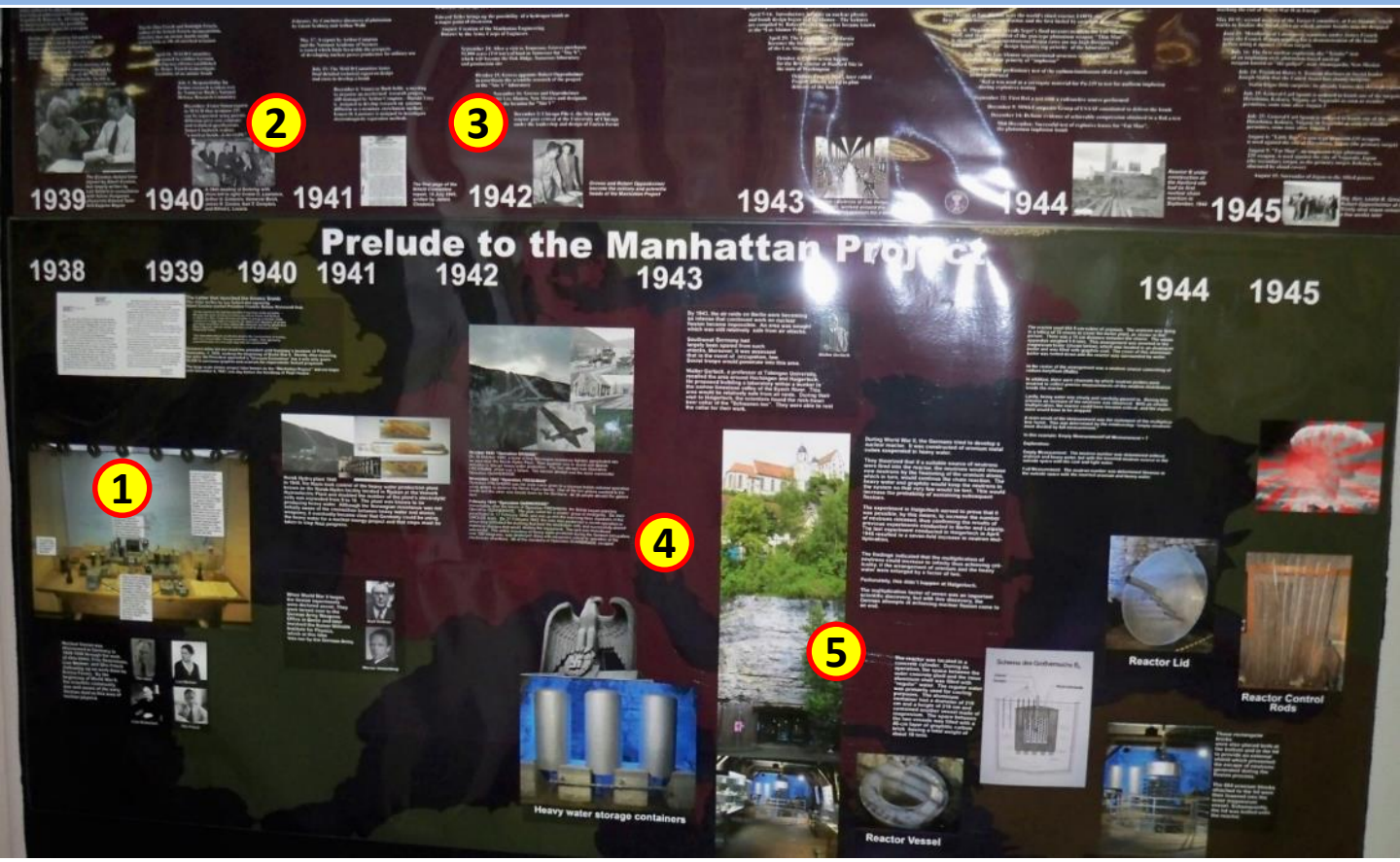
Lobby – 1950 Crash, B-29 Propeller, Bomber Models

1. On 11 April 1950, a Boeing “Silverplate” bomber, serial number 45-21854, took off from Kirtland at 9:38PM. Approximately 3 minutes later it crashed into the Manzano foothills killing all 13 crew. This propeller was brought down from the crash site a few years ago and fashioned into the memorial you see here now. A marker is also being developed for the crash site itself.
2. The B-29 was carrying a MkIV atomic bomb and was the second serious nuclear weapons accident for the Nation, the first occurred off the coast of British Columbia in February of that year. This was however, the first nuclear weapons accident in the continental United States. The conventional explosives partially detonated in the fire after the crash and some unburnt explosives were scattered across the crash site. The weapon was in a safe configuration and a nuclear detonation was not possible. Contamination was not released. DNWS had been training accident responders including bomb disposal personnel on the safe recovery of weapons and hazardous components. School instructors and former students responded to this accident.
3. Boeing B-29 “Silverplate” bomber, Bocks Car.
4. Later B-29’s were given turboprop engines, becoming B-50’s. Production began in 1947 and total of 370 were built with some remaining in service until 1965.
5. The Boeing B-47 became the Strategic Air Command’s workhorse bomber, coming into service in 1951 and finally being retired in 1965.
6. The Northrup-Grumman B-2 Spirit stealth bomber, introduced in 1997 and still in service.
7. (Not to scale) A Rockwell B-1B Lancer bomber, prototypes first flew in 1974 and introduced in service in 1986.

Lobby – Cold War Pop Culture

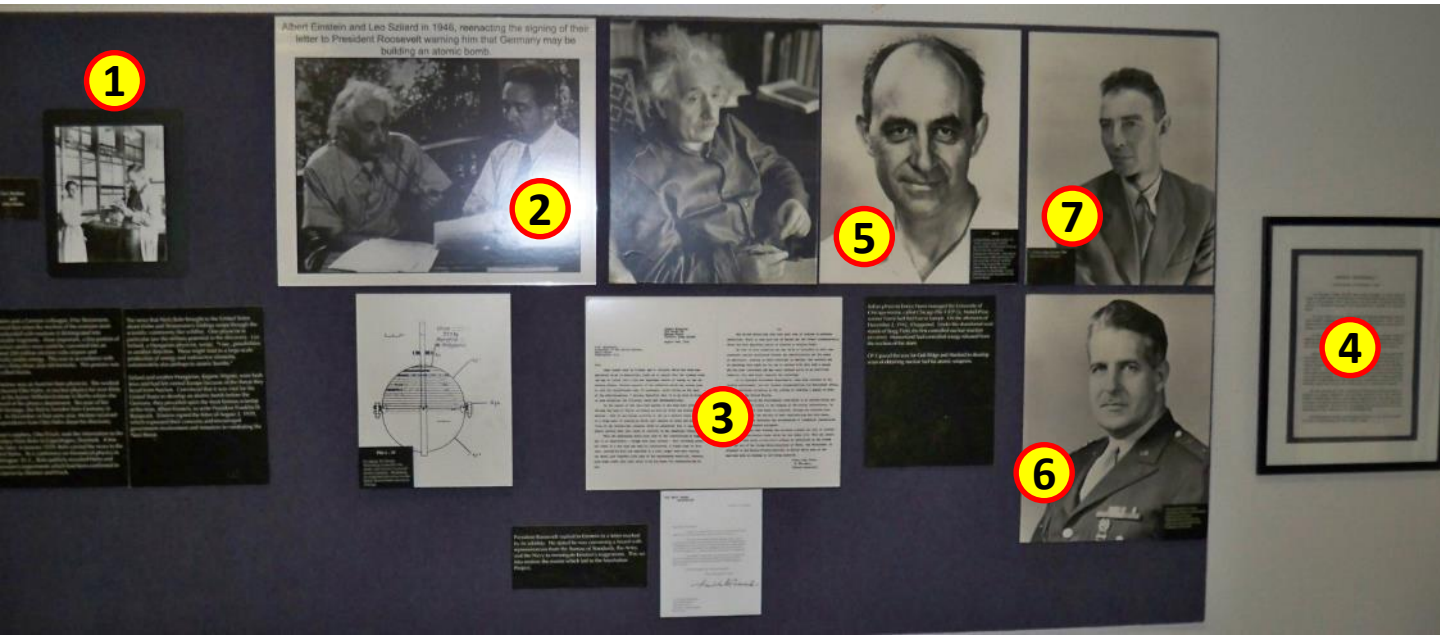
1. The Manhattan Project patch was not authorized for wear until after the war, when the Armed Forces Special Weapons Project (AFSWP) stood up in 1947, it used the same patch.
2. In the 1950's, casinos in Las Vegas hosted trips out to the desert to watch above ground atomic testing and gave out souvenir photos.
3. Jello collector pogs with different missile systems, these were popular during the 60
4. Neutron activated silver dime from the 1964 NY World's Fair. The Atomic Energy Commission used neutron beams to irradiate the dimes making some of the silver into the very short lived radioactive isotopes Ag-108 and Ag-110 (these decayed away before the people left).
5. Atomic bomb salt & pepper shakers and atomic shaver.
6. Kix cereal, 1947 Lone Ranger Atomic Bomb Ring. This is actually a spinthariscope, with a small window of zinc sulfide and a polonium alpha source.
7. GE "Atomic" transistor radio, 1958.
8. Ideal Toy Atomic cannon, 1958.
9. Civil Defense helmet, identification cards and dosimeter pens with charger. The two pamphlets on Civil Defense guidance with the message from President Lyndon Johnson were mailed to households.

Leon Smith Room (Manhattan & Crossroads – Early Testing)



1. (U) 1938, Fritz Strassman and Otto Hahn identified barium in a sample of uranium that they had been bombarding with neutrons at the Kaiser Wilhelm Institute in Berlin. Their colleague, Lise Meitner had fled Nazi Germany earlier that year. While Hahn and Strassman were reluctant to recognize their results as "bursting" atoms of uranium, Meitner and her nephew Otto Frisch confirmed the results and it was Meitner that coined the term "fission." 1939 – Nazi Germany invades Poland and WWII begins.
2. (U) 1940 - 41, MAUD committee begins discussing uranium and the feasibility of an atomic bomb. James Chadwick concludes that a bomb is inevitable.
3. (U) 1942, the Manhattan Project begins
4. (U) Norsk Hydro and the production of heavy water (deuterium) which was vital for German scientists and their reactor design. The "B8 experiment" as the reactor was known, never became critical. It used 664 uranium cubes, material forensics determined that uranium came from Czechoslovakia. Between 1.5 to 2 tons of uranium was recovered by the ALSOS mission, the world's first WMD site exploitation.
5. (U) 1943, the German bomb program under Werner Heisenberg builds a prototype heavy water reactor beneath the Haigerloch castle and church in an old limestone cave. The cave used was an old beer keller.

Leon Smith Room (Manhattan & Crossroads – Early Testing)



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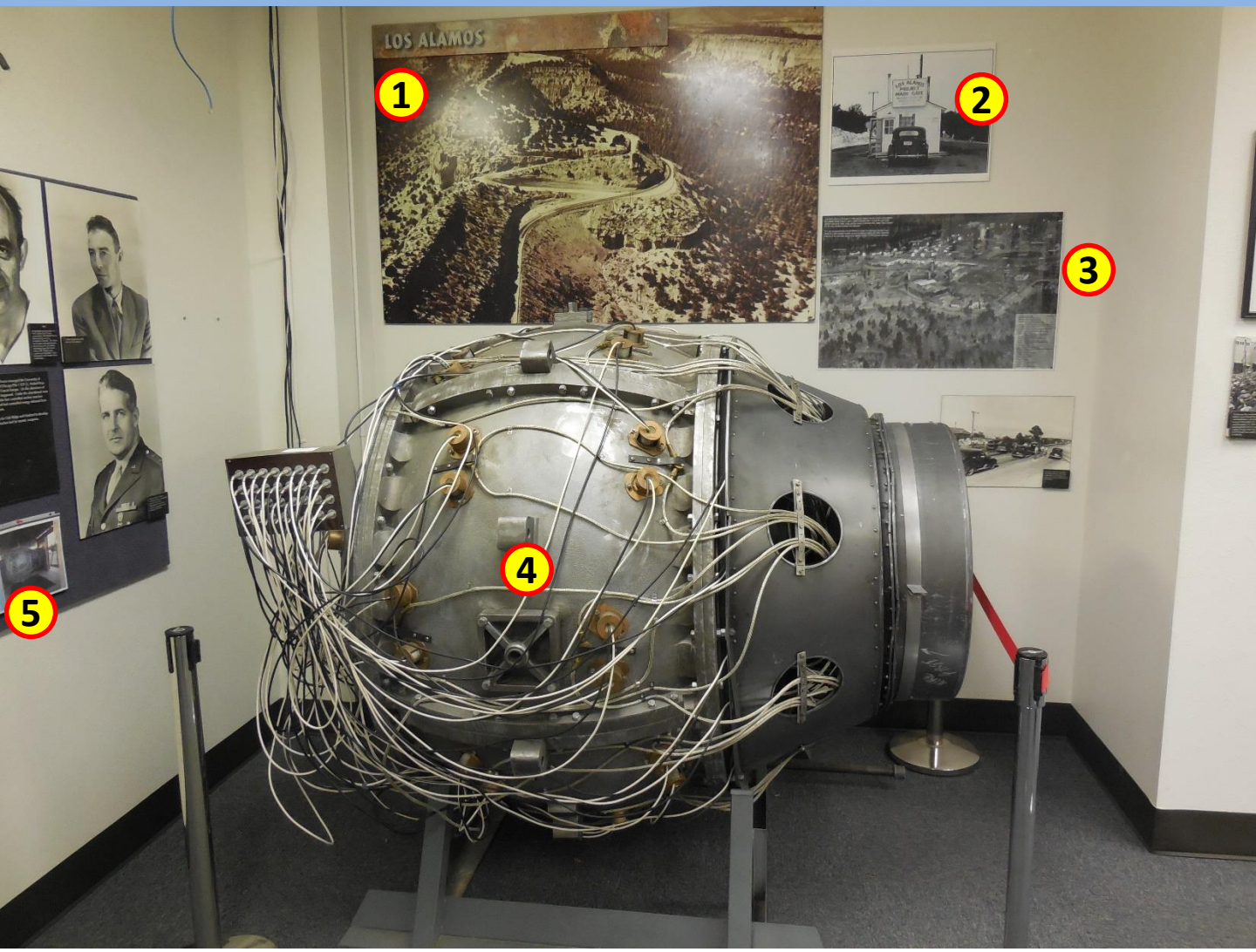
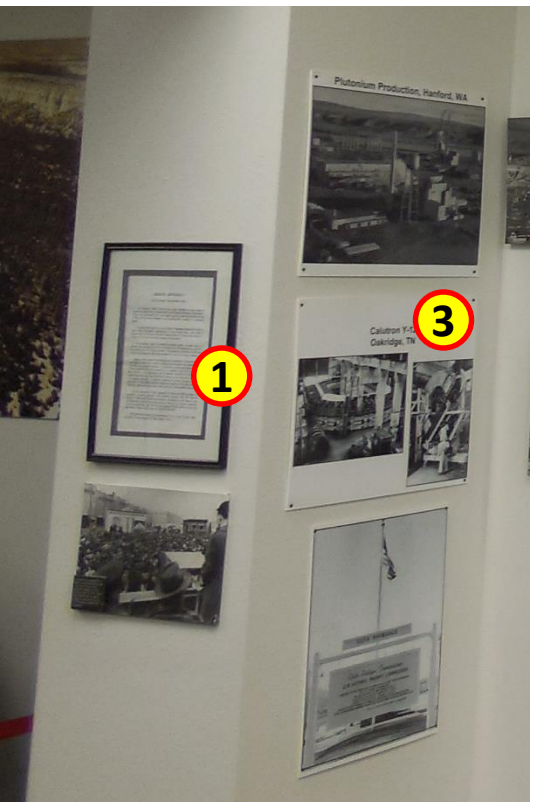
2. (U) 1939, physicist Leo Szilard writes a letter to President Roosevelt urging the United States to begin working on an atomic bomb before the Nazi's develop theirs. At the time very few knew who Szilard was so he got Albert Einstein to sign the letter.
3. (U) The letter delivered to President Roosevelt on 11 October 1939 by Alexander Sachs and influential banker and economist with access to Roosevelt.
4. (U) Roosevelt initially authorized $6,000 for Fermi and Szilard to purchase uranium and graphite to begin experimental work. This humble beginning grew into the Manhattan Project which cost approximately $2 billion dollars in 1945 ($27 billion in 2017).
5. (U) Enrico Fermi, an Italian physicist defected in 1938 after receiving a noble prize for his work with uranium. In 1942 he designed and had built the first graphite pile reactor able to sustain a chain reaction in a racquetball court at the University of Chicago. The reactor was called Chicago Pile – 1 (CP-1). It was later dismantled and moved outside the city into Red Gate Woods a forest preserve and future home of Argonne National Labs.
6. (U) Colonel Groves (retroactively promoted to LTG in 1948), a civil engineer, he completes the Pentagon ahead of schedule and under budget and is called in to lead the Manhattan Project and immediately promoted to Brigadier General. Groves is the driving force behind the Manhattan Project and later the establishment of the modern nuclear enterprise. Groves creates the Armed Forces Special Weapons Project in 1947 as the military successor to the Manhattan Project to compliment the newly formed Atomic Energy Commission.
7. (U) A controversial decision by Groves is the selection of Oppenheimer as a his chief scientist to help manage the Manhattan Project over several Nobel Laurates. Oppenheimer grasps the multitude of complex hurdles that the scientists and engineers are struggling with and can help bridge these topics with the military and political leadership. Oppenheimer hosts cocktail parties on Los Alamos to help encourage the exchange of ideas, balancing academic concepts with a focus on deliverable solutions.

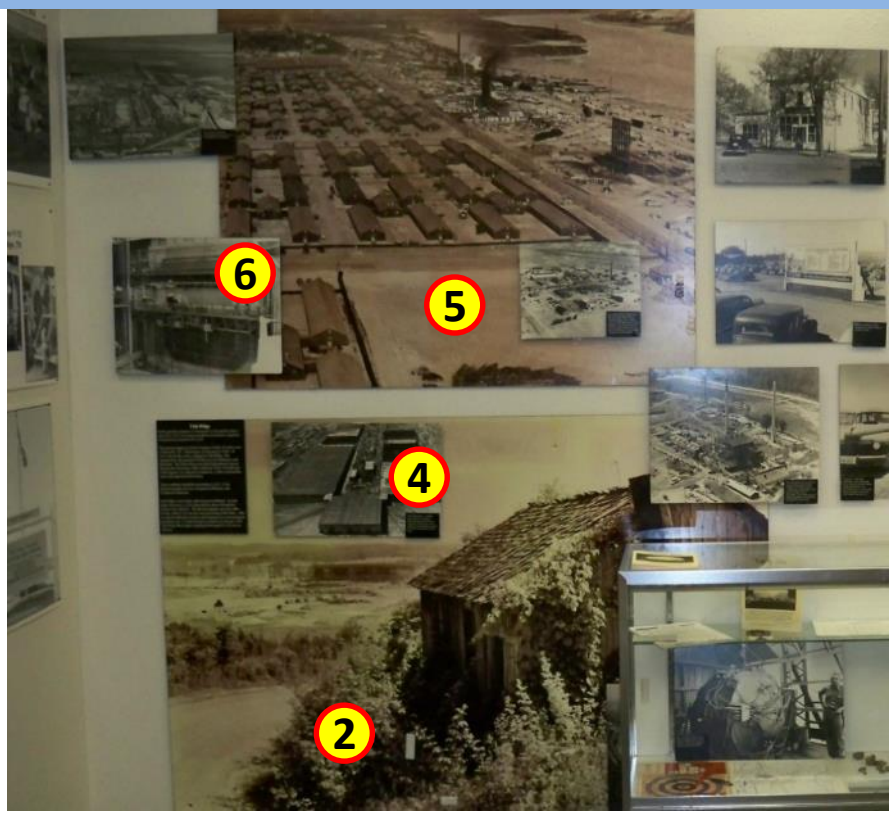
Leon Smith Room (Manhattan & Crossroads – Early Testing)



1. Having fallen in love with the areas desolate beauty, Oppenheimer heavily influenced the decision to create a weapons lab on the Pajarito Plateau.
2. After driving up the winding road onto the mesa, everyone had to have their badges checked. Every family member living on “the hill” had to be badged.
3. Los Alamos was also code named “Site Y” and was responsible for bomb designs.
4. Oppenheimer did not think that the implosion design would work, while the physics of imploding a subcritical mass into a greater density, creating a supercritical mass seemed straightforward the technological hurdles were great. To test their design, the Manhattan Project engineers and scientists built “Gadget” to test at the Trinity Site. The wires were all connected to instrumentation for the test.
5. This replica was actually made for the Manhattan TV show and donated to the school by Lions Gate Films. Visually, this replica is stunning, but it is only made out of fiberglass. The gadget at the National Museum of Nuclear History and Science (NMNHS) outside the base uses an actual aluminum case. The “brass” caps over test leads are actually painted cat food cans. The chalk marks are also copied from Trinity test photos.

Leon Smith Room (Manhattan & Crossroads – Early Testing)

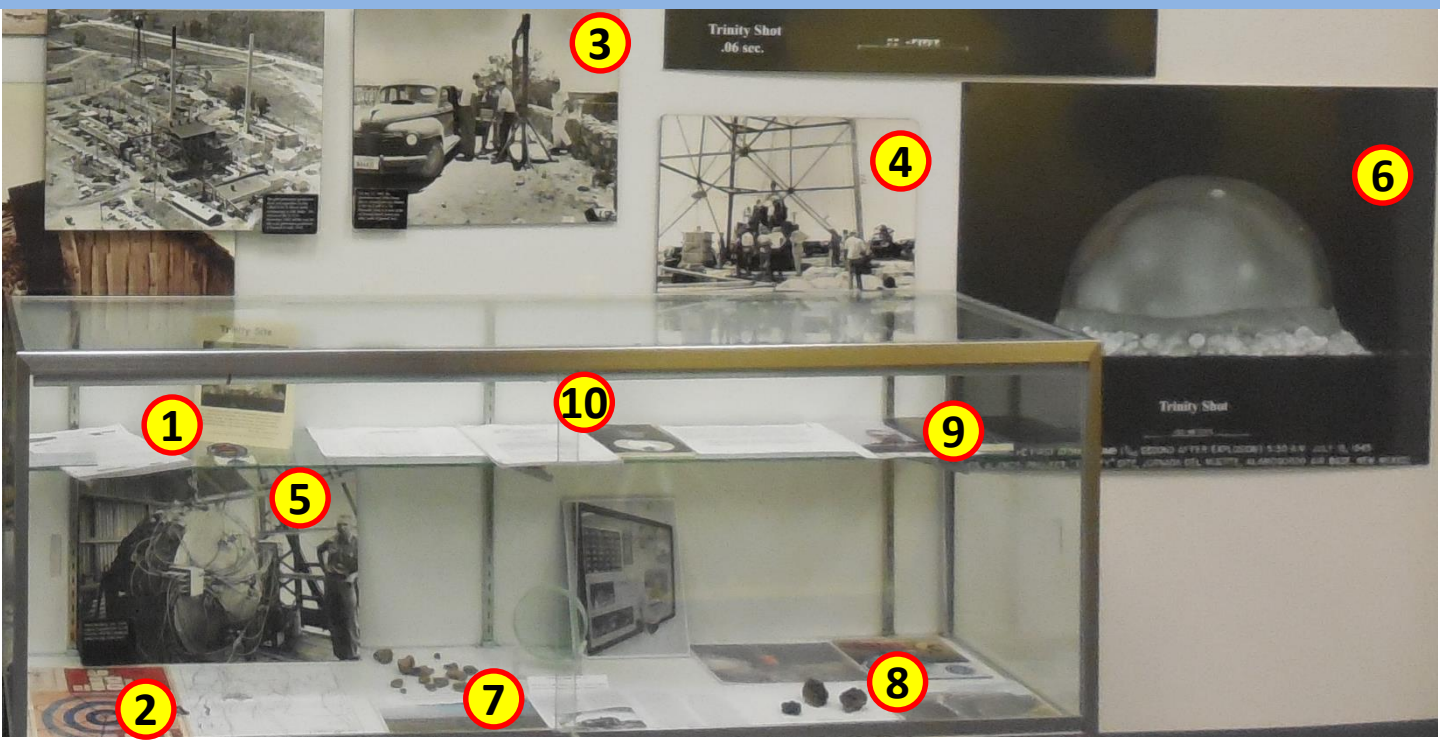




1. President Roosevelt's original outlay for $6,000, grew to $2.2 billion spent by the Manhattan Project in 1945. That is roughly $30.5 billion today (2018).
2. While the theoretical work, experiments and bomb designs developed at Los Alamos were important, the majority of the Manhattan Project budget went into creating Oakridge or the "Clinton Engineering District" and later Hanford or "Site W." The site for Oakridge was chosen for its proximity to the Depression Era Tennessee Valley Authority (TVA) hydroelectric project. Early enrichment techniques required massive amounts of electricity and in their books, LTG Groves and MG Nichols estimate that they used between 10 – 14% of the Nation's total electrical output for the Manhattan Project. This was an over estimation and the actual number was closer to 1%, but considering the massive amounts of electricity used by all the wartime factory's across the U.S. which averaged 272.8 billion kWh per year between 1943-45, this is still a huge national effort.[1]
3. Calutrons developed by Ernest Lawrence were scaled up at the Oakridge Y-12 electromagnetic plant to use electro-magnetic fields to separate isotopes of uranium. Everyday the collector plates were rotated out and micrograms of uranium-235 were extracted. A collector plate like the one in the illustration here can be seen at the NMNHS (museum located off base). The calutrons used massive amounts of copper (5,000 tons) which became increasingly scarce during the war, in 1942, then a LTC, Nichols met with the undersecretary of the treasury and requested six thousand tons of silver. Eventually 14,700 of silver were used and in May 1970, the last 67 tons were returned to the treasury.
4. Calutrons were ultimately inefficient, centrifuge technology which is widely used today was not yet available so gaseous diffusion was pursued in parallel to the calutrons at the urging of the British. K-25 was built to house the cascades, at two million square feet it was the largest building in the world. Gasous diffusion uses fine metal membranes to filter isotopes of uranium.
5. In order to also pursue plutonium, first isolated by Glen Seaborg in August 1942, foundations for three graphite reactors and three massive plutonium processing plants began in 1943.
6. A view of a Hanford graphite reactor, based on the prototype X-10 reactor at Oakridge, construction began on the Hanford reactors before the X-10 first went critical in November 1943.

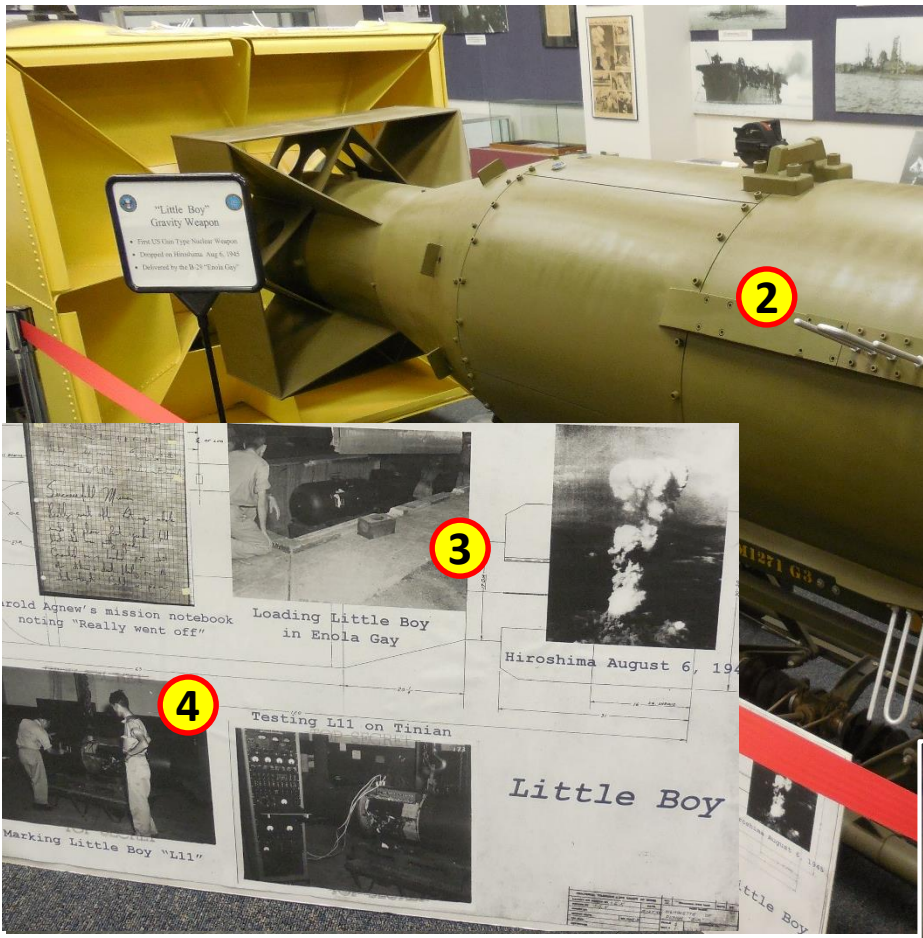
1. https://www.aps.org/units/fhp/newsletters/spring2015/oak-ridge.cfm

Leon Smith Room (Manhattan & Crossroads – Early Testing)



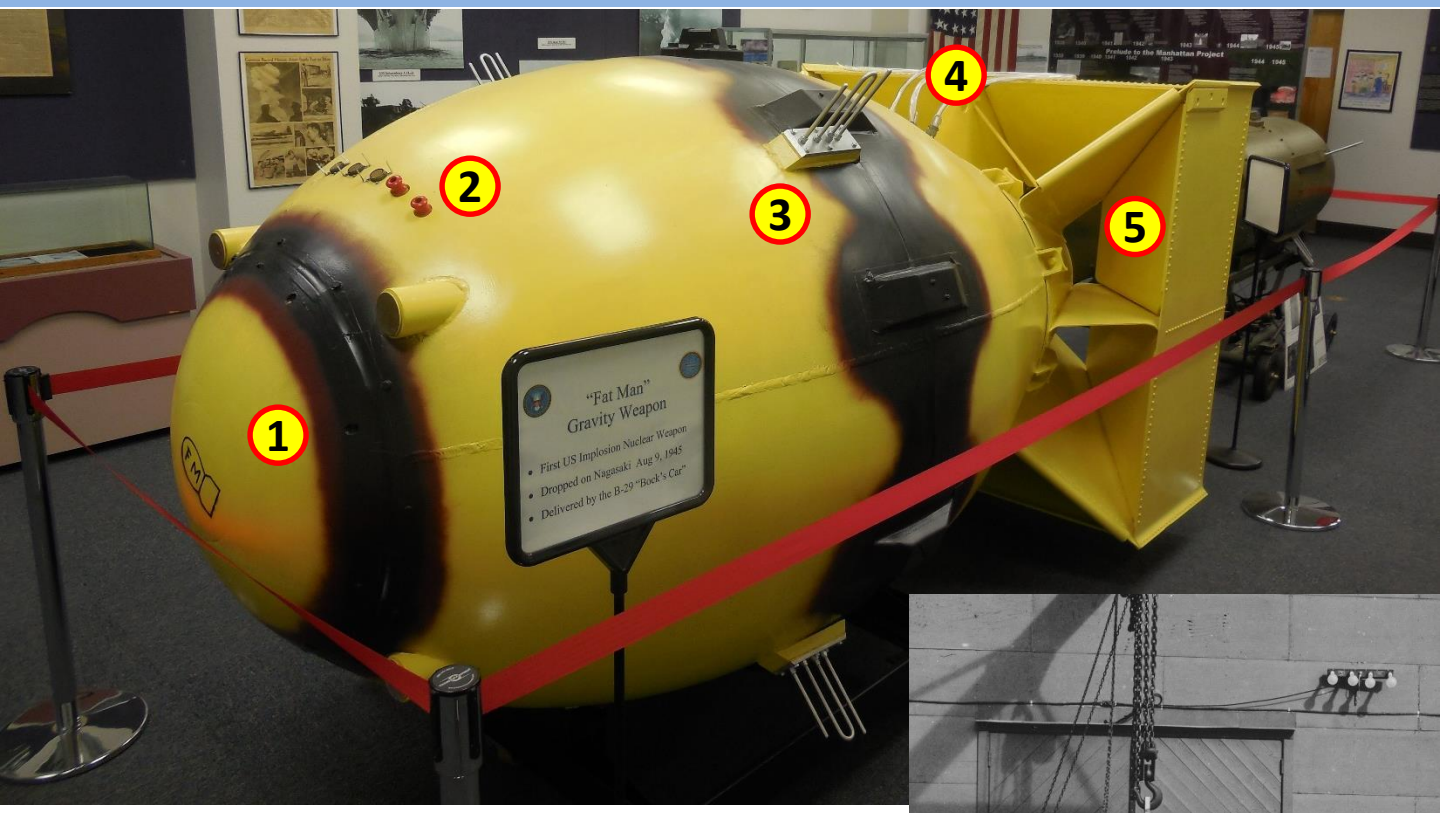
1. The DNWS Partnership Training & Education Program works closely with the White Sands Missile Range to help lead tours to the Trinity Site. The test was needed to make sure the implosion weapon would work.
2. McDonald Ranch house was set up as an improvised 'clean room' to assemble the plutonium core of the gadget.
3. SED SGT, Herb Lehr and physicist Harry Daghlian transporting the core to a waiting Plymouth just outside the McDonald Ranch House on 12 August.
4. Before hauling the actual atomic gadget up the 100 foot tower, a mock gadget was practiced with in the weeks before the test.
5. Norris Bradbury, the second director of Los Alamos National Lab (LANL) on top of the tower with the fully rigged gadget on 15 July 1945.
6. On 16 July 1945 gadget was successfully tested with an approximate yield of 21 kilotons.
7. Green glass or trinitite was formed when sand sucked up into the fireball rained back down and coated the test area. These samples were legally collected as part of a DTRA/LANL study, collecting of trinitite from the site today is illegal as it is national monument.
8. On 17 July 1945 the Potsdam Conference began and during the conference, President Truman informed Stalin that America now possessed a powerful new weapon, Stalin was unphased by this news and coolly informed Truman, "I hope you use it wisely." The reason Stalin wasn't surprised was due to espionage, on 29 August 1949, years ahead of intelligence estimates, the Soviets detonated Joe-1 or RDS-1 (aka "Fatmanski"). This black glass or "joeite" was collected by former DTRA senior scientist Dr. Byron Ristvet at the Soviet test site in Semipalatinsk. Pictured are bunkers covered with the black glass.
9. E.B. Held's "Spys Guide to Santa Fe and Albuquerque" details some of the espionage going on. Klaus Fuchs, a German physicist and implosion expert with the British mission was also a communist and decided to pass along tremendous amounts if information.
10. Published in 1992, "Myths & Realities of the Soviet Atomic Program" was written by Yuli Khariton one of the leading Soviet atomic bomb scientists. In it he states, "the whole of the Soviet Union owes a huge debt of gratitude to comrade Klaus Fuchs for all of the information he shared."

Leon Smith Room (Manhattan & Crossroads – Early Testing)



1. This is only a wooden model of a Little Boy bomb until we can get an unclassified bomb to put on display. This wooden model originally hung over a target effects map of Hiroshima.
2. In October 1946, after the Crossroads tests, the Navy ordered 18 Little Boys since they had no way of delivering Fat Man type bombs. On our classified cutaway Little Boy and the Little Boy on display at the museum off base, you can see an anchor stamped by the serial numbers on the Yagi antenna bases.
3. While 16 Little Boy's were originally constructed for flight testing and drop testing, they didn't conduct a full test until they dropped L-11 over Hiroshima on August 6th.
4. This poster, created by Dr. Glen McDuff shows testing the electrical system of the Little Boy.

Leon Smith Room (Manhattan & Crossroads – Early Testing)

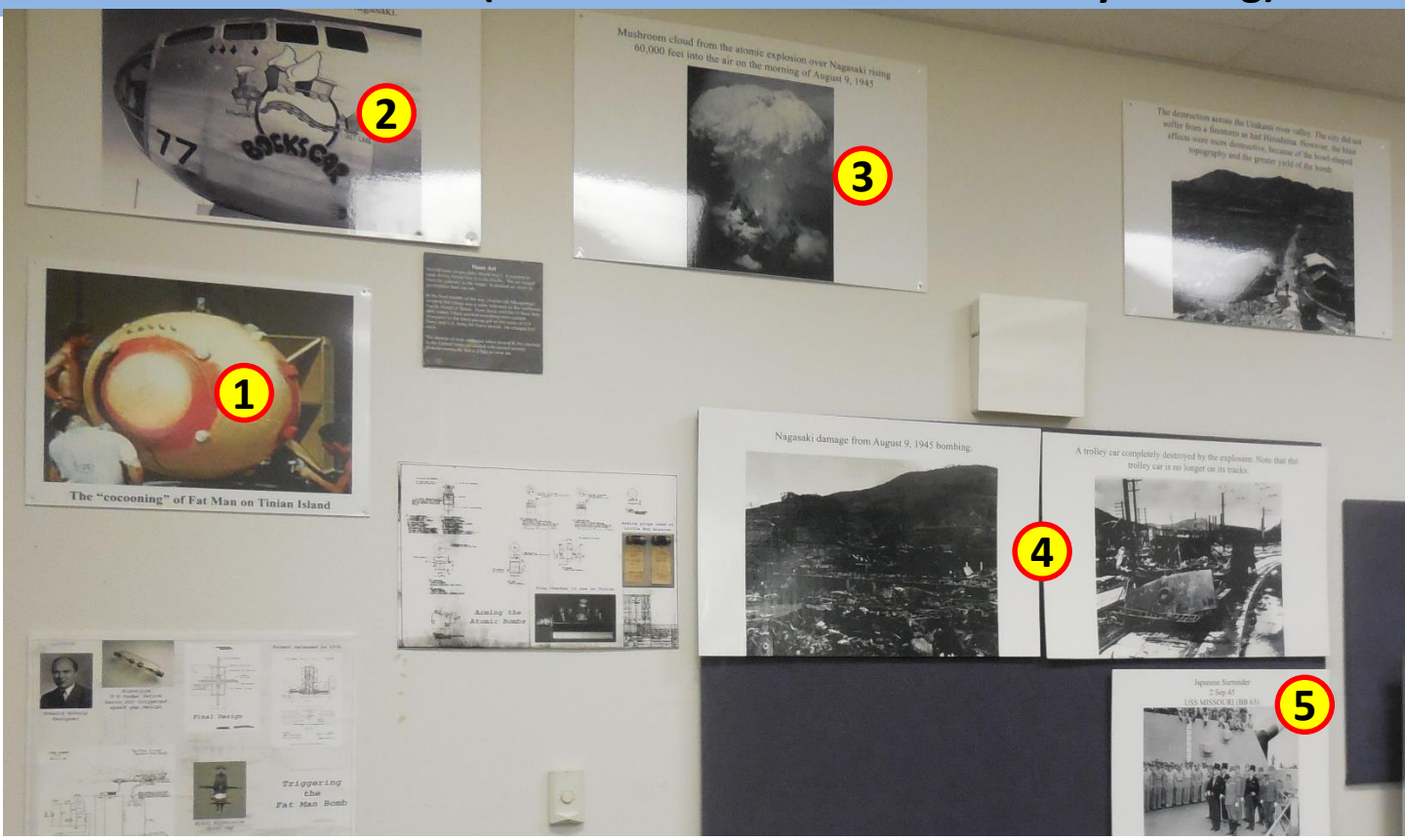


1. This is an actual stockpiled Fat Man bomb case, originally painted green, it was repainted for the dedication of the Leon Smith Room in 2010. It is painted primer yellow with simulated sealant painted on the joints as well as the "FM" bomb stencil on the nose.
2. This is one of the most accurate representations of the Fat Man on display, it includes it's electrical connectors and reproduction arm/safe plugs (red indicates the bomb is armed).
3. Yagi antennas, directional radar used for height of burst. Their use was a closely guarded secret during the Manhattan Project to keep Japanese intelligence from recognizing them.
4. Instrumentation cables for the bomb that would connect to test and diagnostic equipment in the bomber.
5. Box fins were a poor aerodynamic choice for this ungainly weapon. The Manhattan Project had 16 Noble Laurates (before and after the war) with the best physicists, chemists, metallurgists and engineers but evidently no aerodynamic engineers. Drop testing at Wendover indicated instability and air dams were added to help create drag but the heavy early bombs still had a tendency to wobble.
6. While this Fat Man is very accurate, the DNWS team did not attempt to recreate the extensive graffiti found in pictures of the original bomb.

Leon Smith Room (Manhattan & Crossroads – Early Testing)

1. Prior to firebombing Japanese cities, thousands of leaflets were dropped warning of the destruction that was coming. On the night of March 8th, 200 bombers firebombed Tokyo killing ~100,000 more than either atomic bomb. The Emperor became involved in the military government's decision making at this point.
2. Leaflet warning of new "super bombs" and warning Japanese to get out of the cities, dropped prior to Hiroshima.
3. On August 6th 1945 at approximately 8:15AM, the Enola Gay dropped Little Boy or "L-11" over Hiroshima. Hiroshima was the headquarters of Field Marshal Shunroku Hata's Second General Army and a major military supply and logistics hub. Estimated prompt (that day) casualties are approximately 68,000 to 72,000, primarily from the fire storm created when the city caught fire.
4. Notebooks of photos taken after Japanese surrender showing the damage from the bombs.
5. Leaflets dropped prior to the second atomic bomb being dropped on Nagasaki.
6. After the war, Japanese industry was severely limited and was only allowed to produce items like this ceramic souvenir clock with the hands frozen at 8:15AM.
7. Wooden battleship made in occupied Japan after the war.
8. Atomic bomb game.
9. 509th Bomb Group yearbook.
10. Coke bottle from Tinian, while bomber crews and GI's had access to beer, Coca-Cola was very hard to get overseas during the war. The fact that the 509th had lots of the soda was a giveaway that they were a special outfit. This bottle most likely is from the 509th area.

Leon Smith Room (Manhattan & Crossroads – Early Testing)

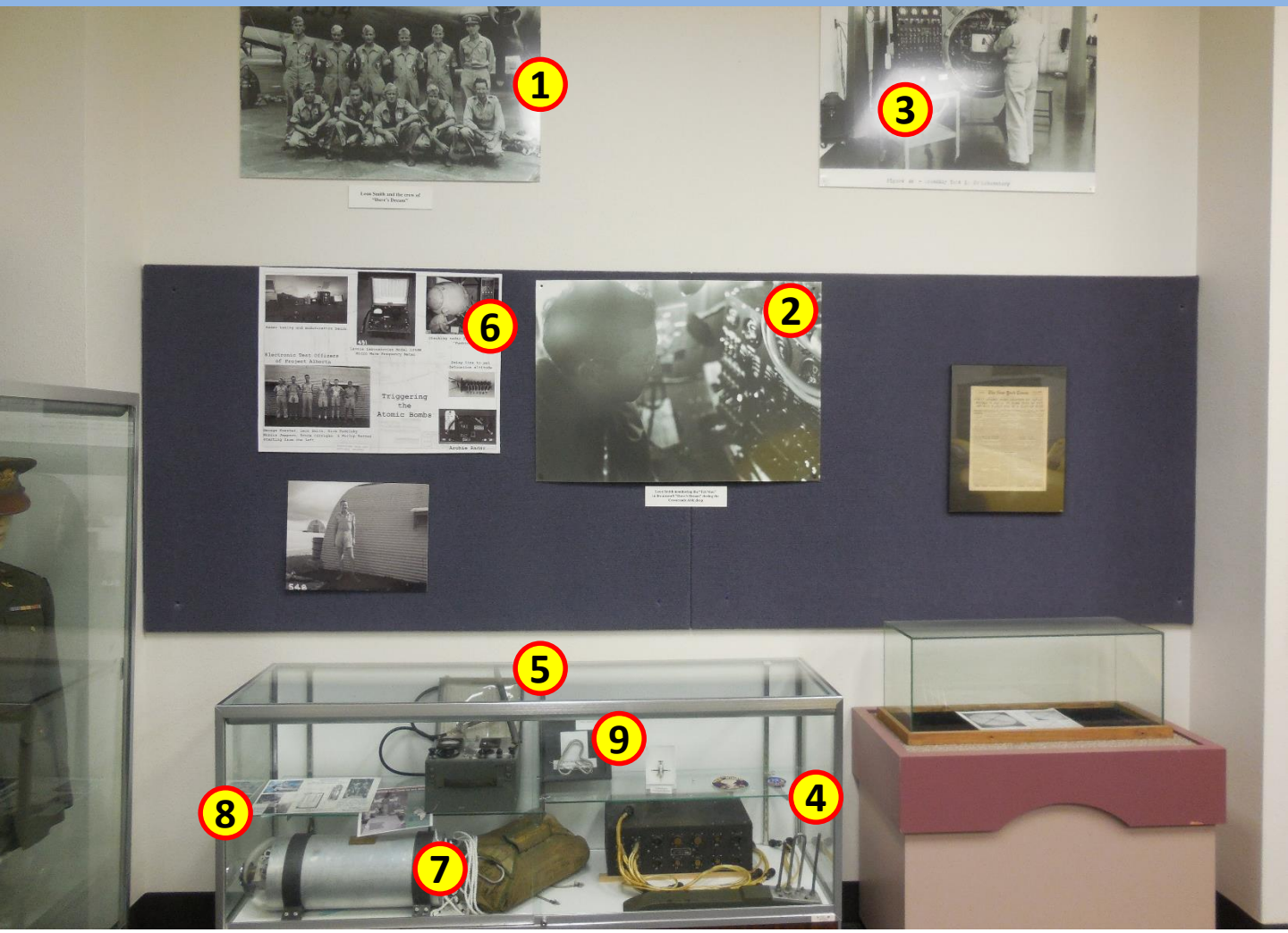


1. Fat Man at Tinian showing the primer yellow, graffiti is not visible in this picture.
2. Originally the second atomic bombing mission was scheduled for 11 August 1945, weather caused the mission to be moved up early to 9 August. MAJ Sweeney, commander of the 393rd Bombardment Squadron Heavy under Col Tibbets was chosen to lead the second mission but his plane, "the Great Artiste" was still set up as an instrumentation plane recording data from the Hiroshima mission. MAJ Sweeney traded planes with CPT Bock for the second mission. If you look at the side of Bocks Car, it shows 5 Fat Man silhouettes, four black and one red. These represent conventional explosive "pumpkin" drops over Japan and the red indicates the Nagasaki drop of Fat Man. The 509th flew multiple missions over Japan before and after the atomic bombings to perfect the delivery method. The Great Artiste was on both the Hiroshima and Nagasaki missions and was the only 509th bomber to have two red Fat Men stenciled on the plane. This nose art is after the war as the original bombing mission was going to Kokura, Japan not Nagasaki. Finding Kokura obscured by smoke fires from a neighboring Japanese city, MAJ Sweeney diverted to the alternate target of Nagasaki. Critically short of fuel after the bombing run he had to make an emergency landing at Okinawa.
3. At 10:58 on August 9th, 1945 the Fat Man bomb dropped by MAJ Sweeney and his crew from 30,000 feet detonated at a height of approximately 1,650 feet and a yield of 21 kilotons.
4. The bomb was 1.5 miles NW of the planned target about midway between the Mitsubishi Steel & Arms Works and the Mitsubishi-Urakami Ordnance Works. Because the aiming point was off, there were fewer casualties, approximately 35,000 people were killed.
5. Even after both atomic bombings and the fire bombing campaign, on August 10th, the Japanese military government voted 3 to 3 to continue fighting, the Emperor now more active in the decision process broke the tie and voted for surrender. Despite this decision, the Japanese military attempted a coup on the night of August 14th before the surrender announcement. The Emperor survived the coup and his recording announcing the surrender was heard on 15 August, the first time the Japanese public had ever heard his voice. He specifically mentions the terrible new weapons as the reason to surrender and on 2 September 1945, Japan signs the surrender instrument on the USS Missouri.

Leon Smith Room (Manhattan & Crossroads – Early Testing)

1. Leon Smith was a Special Engineer Detachment Lieutenant in support of the Manhattan Project. Initially entering the Army as an enlisted artilleryman, his college and technical skill won him a commission and additional schooling on radar and electronics at Harvard and Yale before being reporting to duty with the Manhattan Project. An electrical engineer, Leon Smith's main work was on electrical fuzing and firing of the atomic bombs. Here he is pictured on Tinian.
2. In 2010, the DNWS dedicated this room to Leon Smith, after 30 years at Sandia National Labs, Mr. Smith was a frequent guest speaker at DNWS courses. He passed away in October 2012 at the age of 92.
3. Leon Smith helped develop the "Arm/Safe" plugs, one of four qualified weaponeers to go to Hiroshima and having lost the coin toss, Leon Smith did not go on either mission over Hiroshima or Nagasaki. Later on the Crossroads Able test, when he armed the bomb he kept the green "Safe" plug which his family still has today.
4. After a museum tour in 2015, Brad Smith, Leon Smith's son, and also a career Sandia engineer, appreciated the continued work by the DNWS team to share this history and loaned his father's survival vest and flight skull cap to the DNWS museum. The vest was still fully stocked and in pristine condition.
5. The Smith family also loaned the DNWS museum his father's World War II dress uniform for display here.

Leon Smith Room (Manhattan & Crossroads – Early Testing)



1. Leon Smith is shown here with the crew of Dave's Dream in 1946, after the McMahan Act came into effect in January 1946, civilian control was required of special nuclear material. One of the few people qualified as a weaponeer, Lt Leon Smith was mustered out of the Army on the flight line and went to work for the Manhattan Project as a civilian. Mr. Smith recalled the whole process took about 30 minutes.
2. Leon Smith in Dave's Dream at the test unit which monitored "Gilda" the nick name given to the Fat Man that was used during the Crossroads Able test.
3. In about 30 hours, working around the clock, Leon Smith helped to design and build the early atomic bomb test units used in the aircraft and on the ground to monitor the bombs.
4. Invented in 1926 in Japan, the Yagi-Uda antenna was patented by Hidetsugu Yagi and this patent was then sold to British Marconi Company. Yagi directional antennas were simple and used widely in World War II, especially in aircraft. Some U.S. planes used an "Archie" vacuum tube radar (based on the British "Monica" radar as a tail warning radar. Here is a modified AN/APS-13 "Archie" radar unit with a Little Boy Yagi antenna. Four separate radar units were used on these early bombs to trigger the bomb at the correct altitude.
5. Test set for checking frequency and signal strength of radar triggers.
6. This poster created by Dr. Glen McDuff shows the test set in use at Tinian.
7. Air dropped blast gauge developed by Harold Agnew and Luis Alvarez.
8. Data tape from blast gauge runs.
9. Pull handle from reserve parachute used on one of four blast gauges dropped over Hiroshima, from Harold Agnew collection, donated by Dr. Glen McDuff.

Leon Smith Room (Manhattan & Crossroads – Early Testing)

1. Crossroads Able, 1 July 1946 (local) was an air drop over a target fleet of surrendered and decommissioned ships. In this photo the rarefication layer (moisture in the clouds) shows the blast wave from the air burst.
2. The same test with the mushroom cloud growing, notice the smoke rising from each ship, this is the paint and anything combustible burning from the initial thermal pulse.
3. The mushroom cloud continues to grow, notice most of the target ships are quite a distance from the mushroom cloud. Only five ships were actually sunk on this test as the bomb was 710 yards off target.
4. The Crossroads tests made front page news ad caused French designer to name his two piece bathing suit after Bikini Atoll.
5. The 25 July underwater Crossroads Baker test was more successful being centered on the target fleet. Here we see the USS Independence before and after. Nine ships were sunk on this test.
6. Crossroads Baker, the USS Skate, before and after the test. The superstructure is largely damaged but the sub could still motor around the lagoon when a crew went on board. The Navy was going to repair and recover some of the target fleet but they needed to decontaminate the ships which were now covered in fallout.
7. Shown here are year books from the Crossroads tests, these pictures show the Navy using sea water to decontaminate the ships but the sea water itself was heavily laden with contamination. The test scientists had warned against conducting the underwater test because of the large amount of fallout, especially with neutron activation products. While the water quenched the fire ball and kept it from rising as high into the atmosphere, it carried much more radioactive debris which was scattered across the lagoon. The subsequent Crossroads Charlie shot was cancelled because of contamination concerns.
8. The Manhattan Project unit patch, not authorized for wear until August 1945. This patch would become the Armed Forces Special Weapons Project Patch in 1947.
9. Fastex camera used in the Crossroads tests, this fast shutter speed film camera was most likely onboard the photography B-29 called “Suella” in the yearbook photo here.

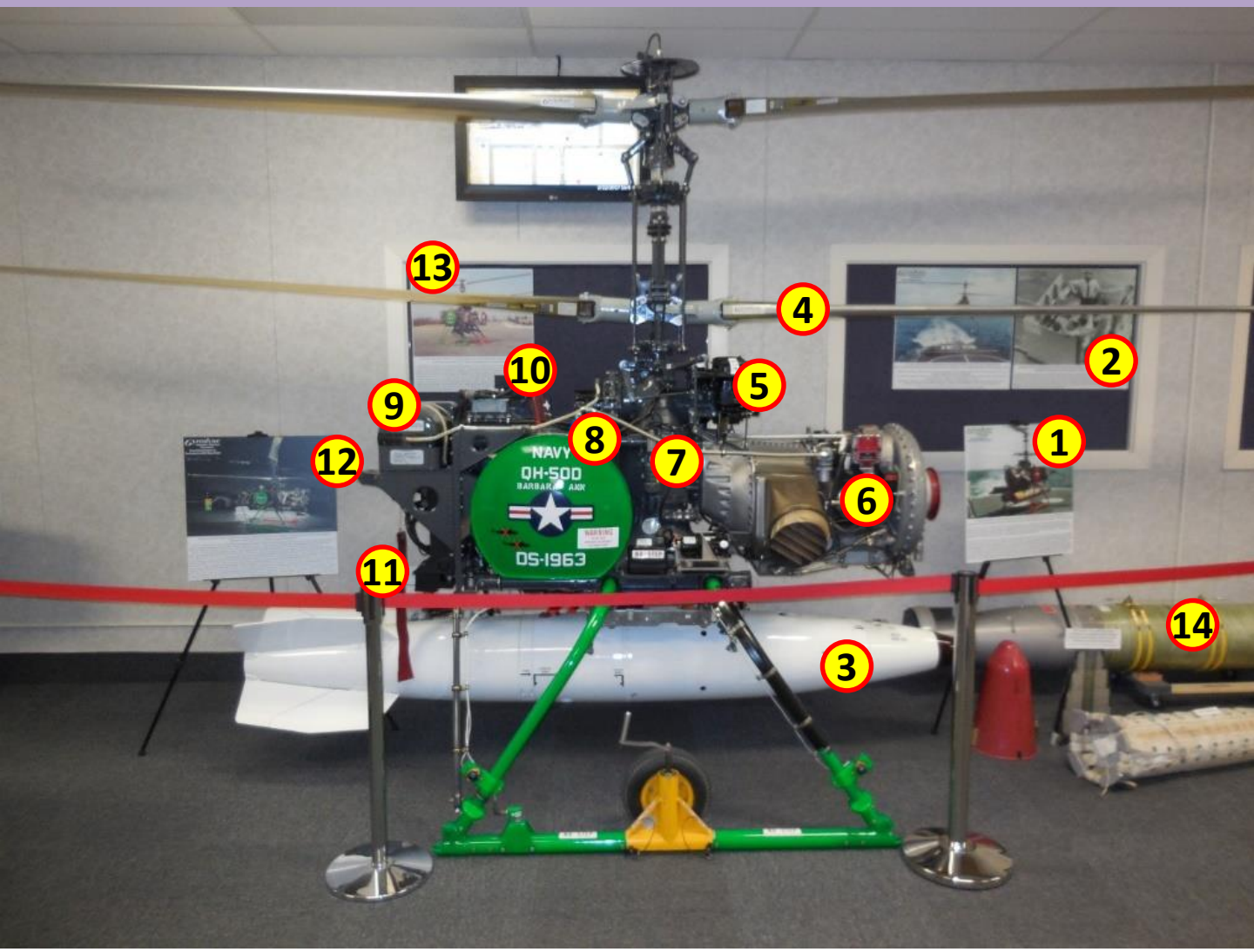
Leon Smith Room (Manhattan & Crossroads – Early Testing)

1. Additional still and fastex motion cameras along with an oscilloscope camera fro regarding data and telemetry during these early tests.
2. Remote control 3 x F6F Hellcats and 8 x B17's were flown through the mushroom clouds at different altitudes to take photos and gather data.
3. Later in above ground testing, jets would be used with special scoops to sample the air around these tests.
4. "Radio Bikini" was an armed forces radio station operated during testing, this picture shows the radio you see here on a barracks room at Bikini Atoll.
5. Yearbooks from the tests.
6. Operation Sandstone were three more National Lab tests conducted at Enewetak Atoll in 1948. Manhattan Project vet Leon Smith and Sandia Pioneer Al Baye were both veterans of this these tests.
7. The Marshall Islands, were the scene of vicious fighting against the Japanese in February 1944. This picture shows victorious U.S. troops on Enewetak after the fighting was over.
8. While the atomic bombings of Hiroshima and Nagasaki were not tests, militaries from around the world wanted to know what kind of damage was caused by these new atomic bombs. Along with early State Department and British Mission effects studies, the Galsstone-Dolan Atomic Weapons Effects books remain the standard reference on nuclear weapons effects. This volume shown here is one of the first editions published in the early 1950's.
9. This is the ensign which flew over the USS Arkansas in World War II. The USS Arkansas was one of the decommissioned U.S. warships used as a target in the Operation Crossroads tests. It was one of the ships sunk on the 25 July Crossroads Baker shot.

Bomb Hallway (Fission to Thermonuclear)

1. The Korean War accelerated weapon development on improved atomic weapon designs, the military needed much smaller weapons to allow for more delivery platforms. The TX5 and TX7 development programs became the Mk5 & Mk7 nuclear weapons with the National Labs working around the clock. These weapons significantly reduced the diameter and weight of early atomic weapon designs, allowing tactical fighter bombers, early cruise missiles and even blimps to deliver atomic bombs.
2. The AGM-62 Walleye was an early precision guided munition which emerged during the Vietnam War. This is a glide bomb which sends a TV image back to the controlling plane and power for the camera and transmitter comes from a propeller normally located at the tail of the bomb. By 1970 atomic bombs were small enough to fit into this glide bomb creating a precision guided nuclear capability which stayed in the service until 1979.
3. The large fins helped to stabilize the bomb on its short glide path to the target with corrections sent from the controlling plane.
4. From 1965 until the 6th of October 1972, the Thanh Hoa Bridge in North Vietnam was an extremely difficult target to engage with 100's of bombs failing to take it out. The bridge survived 32 Bullpup missile hits and thousands of conventional bomb strikes before laser guided and the TV guided Walleye finally took the bridge out by destroying its pilings.
5. the walls you will see plaques that date back through the school's history. These are more focused on Navy and Marine Corps aviation commands. (Pictured here is the DNWS student break area between the Plumbbob and Redwing, lined with some of these plaques)

Bomb Hallway (Fission to Thermonuclear)



QH-50D DASH U.S. Navy Drone

1. (U) This flyable example of the QH-50D DASH drone is one of a handful on display, it is valued at $15M. Conventionally it could be armed with up to two Mk46 torpedoes or one Mk57 nuclear depth bomb. It was produced between 1962 – 1969 and 755 were built serving on 165 Navy ships.
2. (U) It was line of sight controlled from a console as pictured here, control distance was 22 miles.
3. (U) The Mk57 nuclear depth bomb could also be used as a light weight nuclear bomb.
4. (U) The Gyrodyne QH-50 was the first all fiberglass rotor blade used on a production helicopter.
5. (U) The servos controlled the pitch of the blades as well as blade brakes on the tips of each blade.
6. (U) The Boeing T-50 turbine engine was originally designed to be used on a fire truck and repurposed for the QH-50.
7. (U) The transmission weighs 500lbs and turns both sets of blades at approximately 650 RPM.
8. (U) The fuel tank gave it an endurance of 1.5 hours, the “kills” are not real.
9. (U) The flotation pack will float the QH-50 if it should ditch so it can be recovered.
10. (U) The decoder is used to securely communicate with the nuclear weapon.
11. (U) (Not visible here) The antenna is gravity drop design.
12. (U) The radio and ECA are located here.
13. (U) Pictured on the wall is DS-1694 or the “Snoopy” QH-50D which was outfitted with Japanese cameras as a surveillance drone. These could directly spot the fall of 5” naval guns for shore bombardment in Vietnam.

U.S. Army and the Nuclear Battlefield

1. (U) As we learned how to make atomic bombs smaller and smaller, we can start to use artillery to deliver atomic projectiles. Development began on the "Atomic Annie" in 1947, using captured Nazi railway guns and barrels as part of the initial designs. These were developed into 22 atomic cannons that used tandem tractors to move them on the road. The museum off base has one of eight remaining examples on display. The model here was built by Andy Rogulich from the Air Force Nuclear Weapons Center and the original model above it was donated by Dr. Glen McDuff.
2. (U) The inability of strategic nuclear weapons to prevent limited wars became apparent with the Korean War which began on 24 June 1950. While the U.S. was unwilling to use strategic nuclear weapons in the Korean War with the fighting at a stalemate in 1953 and with North Korea unwilling to consider an armistice the well publicized Grable test – pictured here, may have influenced North Korea to the armistice table as talks of an armistice began in June 1953.
3. (U) The 280mm Atomic Annie fired the kiloton range Mk9 or Mk19 projectile here.
4. (U) The ability to use smaller nuclear weapons gave flexibility to commanders and the Nation so we can limit the scale of a nuclear exchange. In the 1950's nuclear tests as part of Operation TEAPOT, in Nevada, included troops to see if military operations could continue in a nuclear battlefield.
5. (U) Even light infantry could have an atomic capability with the spigot launched recoilless rifle known as the Davy Crockett. The atomic projectile here is a reproduction donated by Dr. McDuff, he used an Ikea salad bowl for the nose.
6. (U) This version of the Davy Crockett is the 120mm man portable version, 5 Soldiers could carry this onto the battlefield. The 155mm jeep mounted version had a longer range.
7. (U) In 1962 Attorney General Robert Kennedy and General Maxwell Taylor (one of the architects of flexible response) watched a Davy Crockett launched.
8. (U) This Sandia 3D printed Davy Crockett was donated by Dr. Brad Altman.
9. (U) The same B54 warhead was also used in the Special Atomic Demolition Munition (SADM) or "back pack nuke." These demolition devices could blow bridges and mountain passes to slow Soviet armor advances.

U.S. Army and the Nuclear Battlefield

1. (U) The “Atomic Annie” was very cumbersome so the Army sought a smaller nuclear cannon. Pictured here and not currently on display, is the Mk33 which is 203mm or 8” Artillery Fired Atomic Projectile (AFAP). This kiloton class shell was the longest serving nuclear weapon having been in service from 1956 until 1992. At one point the Army had more nuclear weapons than the Navy and Air Force combined with its artillery, battlefield nuclear rockets and missiles and its air defense missiles.
2. Currently not on display, one of the longest serving nuclear weapons in the U.S. arsenal was the Mk33, 8” artillery shell which replaced the Atomic Annie. It was in the inventory from 1956 until 1992.
3. (U) In 1963 the Army received the W48 which is a 155mm AFAP.
4. (U) In 1981 the Army received the W79 which is another 203mm AFAP but this is much more advanced and has rocket assistance which gives it a greater range.
5. (U) On 27 September 1991, President H.W. Bush announced his Presidential Nuclear Initiatives. These unilateral decisions led to the elimination of all U.S. “battlefield” nuclear weapons, overnight the Army was out of the nuclear business. Before the Soviets could reciprocate there was a coup d'état and Boris Yeltsin took over, today the Russians retain their nuclear artillery.
6. (U) Navy battleships also had an atomic projectile for the 16” guns, the Mk23 was in service from 1956 until 1959.

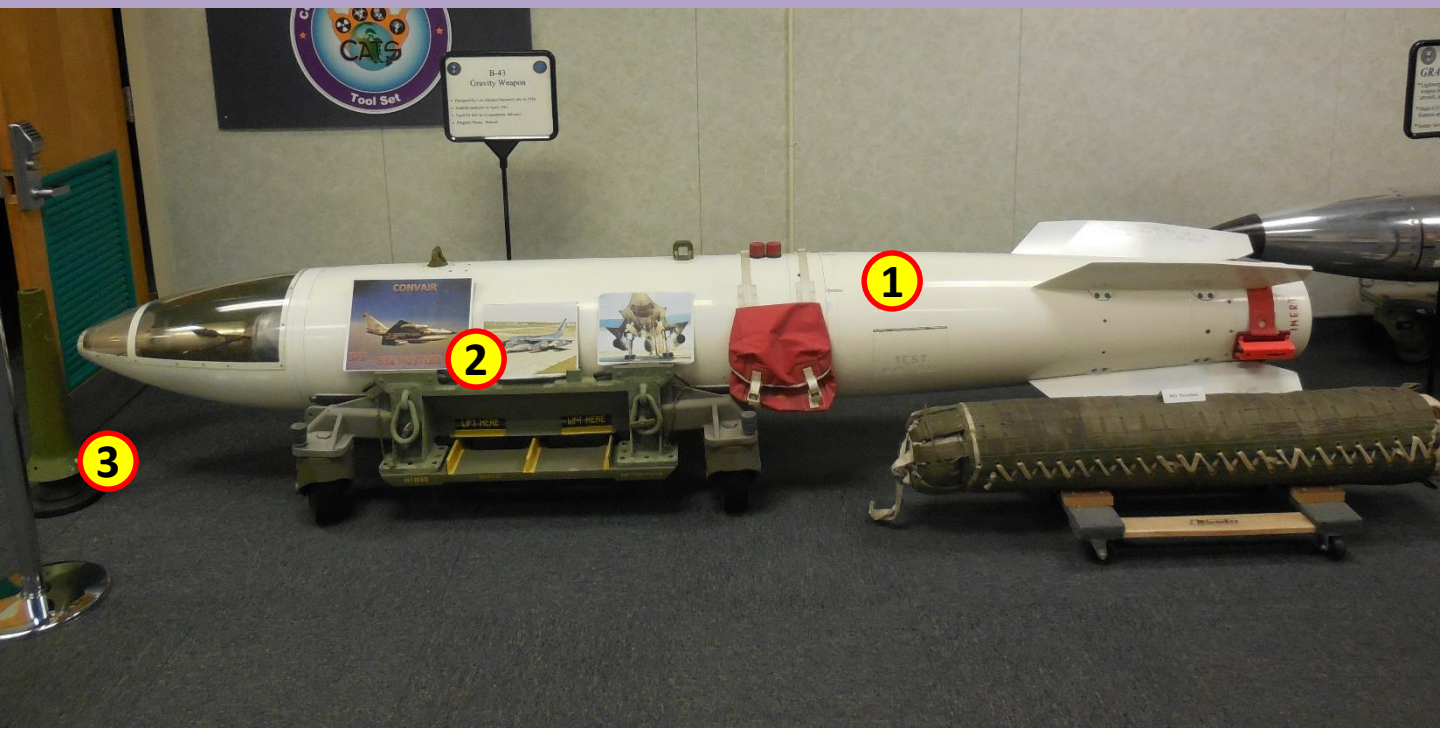
Bomb Hallway (Fission to Thermonuclear)

1. (U) B-53 megaton range thermonuclear bomb, known as the “bunker buster” and retired in 1999.
2. (U) When the bomb was going to be used in a lay-down mode, three massive parachutes would deploy. This is one of three on the cart.
3. (U) To further soften the landing in lay down mode and to cushion the bomb, it was surrounded by aluminum honey comb like you see here. Once on the ground, the tremendous ground shock caused by detonation would crush bunkers.
4. (U) The B-53 was still small compared to some of the first thermonuclear bombs. The 1/72nd scale model here is a B-36 Peacemaker, the largest bomber ever built. An intercontinental bomber, the B-36 could carry two Mk17 or Mk24 thermonuclear bombs.
5. (U) Pictured here is a Mk17 bomb in a saddle loader. You can get an idea of its immense size looking at the technician next to the bomb. It had a single 64’ parachute to slow its descent to allow the bomber to get away before it detonated and it was over 24 feet long and weighed 42,000 pounds.

Bomb Hallway (Fission to Thermonuclear)

1. The B28 was one of the workhorse weapons of the Cold War, megaton range thermonuclear bomb which is smaller than the Little Boy or Fat Man weapons of the Manhattan Project. B-52's could carry up to four of these weapons in a single "clip."
2. The B28, a Los Alamos National Lab design was designed to be modular and had multiple configurations as a bomb or missile depending on the application.
3. Aluminum honey comb is a design feature for shock mitigation if a weapon would have to survive a lay down delivery for ground burst.
4. The parachute would slow down the B-28 as part of lay down delivery.
5. On 17 January 1966, a B-52 collided with a KC-135 tanker off of the coast of Palomares, Spain. The KC-135 exploded and the B-52 began breaking apart with two of the B-28's auguring into the Spanish countryside with the high explosive detonating on impact. While there was no nuclear yield, plutonium was scattered across the countryside. Since plutonium is not naturally occurring, the Spanish government wanted it all removed and the U.S. collected and shipped away 4,800 drums of lightly contaminated soil to Savannah River where it is buried today. This was our 29th serious nuclear weapons accident by this time because of the frequency of nuclear armed flights during Operation Chrome Dome at the height of the Cold War. Here Air Force technicians in coveralls, gloves and masks survey drums of lightly contaminated soil.
6. Here an Air Force technician works next to a Spanish Atomic Energy official to survey a contaminated building. This building is still lightly contaminated and up until 2010 the U.S. government paid reparations to the Spanish for the accident.

Bomb Hallway (Fission to Thermonuclear)



1. The B43 was the first externally carried thermonuclear bomb capable of supersonic speeds. This was megaton yield range bomb.
2. The B-58 Hustler was the height of technology at the time it was introduced in 1960 and was in service until 1970. The Mach 2 bomber could externally carry four B43's. The large J79 jet engines required a large amount of fuel so the bomber almost always carried a fuel pod on its centerline. This fuel pod could also carry a W53 warhead.
3. The arrow spike shown here and on the nose of this B43 was not a penetrator but a shock mitigation device. One method of delivery was to fly at low level and the parachute would pull away and slow down the B43, the arrow spike would jam into the ground and then detonate once the bomber was safely away.

Bomb Hallway (Fission to Thermonuclear)

1. The B61-0, the first B61 model came into the inventory in 1966 and modern models of this bomb have made this the longest serving nuclear weapon in the U.S. inventory.
2. This model is an exact replica of the B61-12, the latest model of the B61 series bombs.
3. Q: Does anyone on the tour know what this parachute is made out of? Have the tour knock on the parachute. A: Kevlar/Nylon Ribbon, this ribbon parachute is packed to the density of oak.
4. These modern bombs have such well designed and protected nuclear sections that DNWS students must also learn about the peripheral components which may present a greater hazard in an accident. The parachute ejecting from the tail (a flying tree trunk) or the spin rocket motor firing on the ground if involved with an accident.

Bomb Hallway (Fission to Thermonuclear)

1. The B83 is in the current stockpile as a strategic bomb with a megaton range yield.

Q: What makes the B83 a strategic bomb?
A: It has nothing to do with size or yield, it is delivered by strategic bombers to strategic targets so it is a strategic bomb. The B61 can be delivered by both tactical and strategic bombers so variants can be tactical or strategic depending on application.

U.S. Missile & Rocket Hallway (Army)

- Army Missiles & Rockets
  1. This hallway has missiles and rockets, it is divided between Army, Navy and Air Force systems. Along with some full size displays, the models are not to one scale and include some training and engineering models. The historic DNWS plaques are grouped by service in this hallway (Navy & Army).
  2. Army systems include the Redstone (first missile in the hallway), this is the same missile that is in front of the museum off base and it is a short range ballistic missile (SRBM) with a conventional high explosive or megaton range warhead. It was designed by Werner Von Braun and the German V2 rocket scientists that worked for the U.S. after World War II. They Army got the Chrysler Corporation to build the missile and it used Ford Motor Company avionics. It was also used as part of the Mercury-Redstone program, so our first astronaut, Alan Shepard road a Detroit copy of a V2 rocket into space.
  3. The Honest John was a long serving Army battlefield rocket (no guidance) with conventional or a kiloton range warhead.
  4. The Army also had primary responsibility for the air defense missile program and the Nike Hercules was the work horse of air defense until replaced by the Patriot missile. It was a conventional or nuclear capable missile and at one point almost every major town or base had a Nike site protecting it.

U.S. Missile & Rocket Hallway (Army)

- Army Missiles & Rockets
  1. Sergeant missile was a solid fuel battlefield missile eventually replaced by the Lance missile with its W70 warhead.
  2. The Little John was a nuclear battlefield rocket, small enough to be used by light infantry units.
  3. The Sprint and Spartan missiles were part of the Safeguard Antiballistic Missile (ABM) defenses of the United States. Spartan was an evolution of the Nike series missiles and after the ABM treaty of 1923 was signed the U.S. and Soviet Union were each limited to two ABM sites, one around the capital and one protecting missile fields. The U.S. only built the one site, the Stanley R. Mickleson Safeguard Complex in North Dakota, it cost $4.6 billion and was only open for 6 months. Moscow still has their ABM site operational. These early ABM systems used nuclear warheads to shoot down nuclear warheads, similar to the video game 'missile command.' Today we use kill vehicles or "bullets to shoot down bullets" with our limited defense ABM defenses.
  4. Pershing I and Pershing II were theater nuclear missiles and the Pershing II was so capable it scared the Soviets into giving up thousands of weapons systems with the Intermediate-range Nuclear Forces (INF) treaty of 1987.
  5. The W85 was the Pershing II's warhead, the INF treaty banned the missiles, not the warheads.

U.S. Missile & Rocket Hallway (Navy)

- Navy Missiles and Rockets
  1. The first Navy submarine launched ballistic missile (SLBM) was the Polaris which was fired from a George Washington class ballistic missile submarine or SSBN. The submarine was simply a Skipjack class nuclear powered attack submarine that was cut in half with missile tubes added. The delicate model you see here was made by the Navy at the Mare Island Naval Shipyard and sent to the school in 1959 to teach our students how the missiles were loaded.
  2. Pictures show the Regulus I and Regulus II cruise missiles which the navy relied on until SLBM's came into the picture.
  3. A few of the Navy's SLBM's were the Polaris 1, 2 and 3, the Poseidon, the Trident C4 with spike (next to a full size warhead) and the current SLBM is the Trident D5.
  4. Along with SLBM's the Navy had nuclear armed torpedoes (the Astor) as well as nuclear armed air defense missiles, Talos and Terrier.

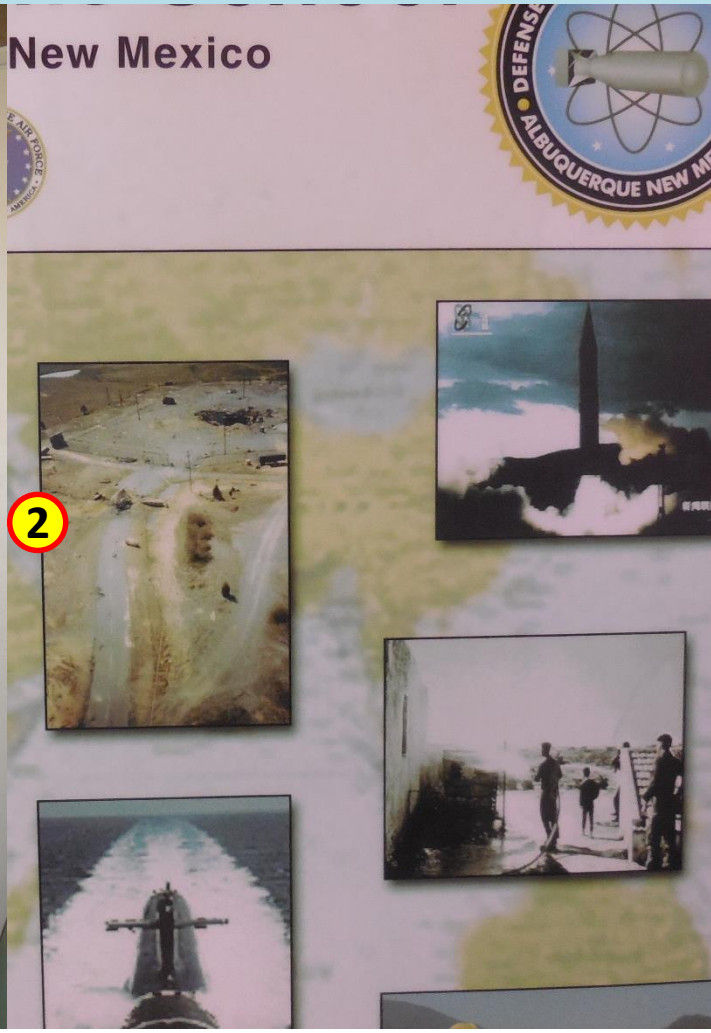
U.S. Missile & Rocket Hallway (Navy)

- Navy Missiles and Rockets
  1. Poseidon C3 SLBM carried W68 thermonuclear warheads.
  2. Mk3 re-entry body for the W68 warhead, the Navy calls these “re-entry bodies” while the Air Force calls them “re-entry vehicles.”
  3. Trident C4, these carried W76 warheads. A full size example is on display at the unclassified museum off base, the National Museum of Nuclear Science & History.
  4. Trident D5, the Navy’s current SLBM can carry either W76 or W88 warheads.
  5. The Navy also had Tomahawk cruise missiles which could carry the W80-0 warheads.

U.S. Missile & Rocket Hallway (Air Force)

- Air Force Missiles and Rockets
  1. The first two Air Force missiles are intermediate range ballistic missiles (IRBM's), the Jupiter and the Thor. Jupiter was originally an Army system but the Air Force lobbied the Secretary of defense to take it from the Army and it became an Air Force system.
  2. The Convair Atlas was the first U.S. ICBM operational (the Soviets beat us with R7 and sputnik in 1957). General Bernard Schreiver struggled to maintain Air Force support to develop the ICBM in the face of intense resistance from General Lemay and the Air Force "bomber generals" that did not see the value of these missiles.
  3. While IRBM's were being fielded and the first Atlas missiles were coming online, other desings were being developed in parallel including the solid fuel Minuteman Missiles. Minuteman I was a solid fuel ICBM with a single warhead ready for a quick launch.
  4. Titan I was another liquid fueled ICBM, this is was stationed across the United States in silo complexes with three missile silos at each site. The missiles would have to be raised up on an giant elevator and fueled with liquid oxygen before launch.

U.S. Missile & Rocket Hallway (Air Force)



- Air Force Missiles and Rockets
  1. The W53 megaton range warhead (seen full size here) went on the Titan II, the largest ICBM the U.S. built.
  2. In 1980 in Damascus Arkansas a fuel handler dropped a 17 pound socket causing a leak in a Titan II missile. For a full day the missile leaked while the silo was evacuated. The next day it detonated as two fuel handlers were heading back into the complex, killing one of them. The devastating explosion launched the 750 ton blast door over 600 feet away, multiple redundant safeties kept the warhead from going off and it was recovered. Damascus was the last serious nuclear weapons accident.

U.S. Missile & Rocket Hallway (Air Force)

- Air Force Missiles and Rockets
  1. Minuteman II was an ICBM with the a single Mk11 re-entry vehicle on display here.
  2. The Minuteman III ICBM could have multiple independently-targetable re-entry vehicles or MIRV's, here is a Mk12 re-entry vehicle. The Minuteman III is our current ICBM.
  3. The MX or Peacekeeper was a much larger solid fuel ICBM designed to replace the aging Minuteman III. In 2005 we retired the Peacekeeper ICBM.

Full Size missiles (Titan II, Minuteman and MX/Peacekeeper) are on display at the museum off base.

DNWS History

DEFENSE NUCLEAR WEAPONS SCHOOL 70th Anniversary

In 1969 the Defense Atomic Support Agency (DASA) opened the unclassified atomic nuclear weapons museum at one of the Nuclear Weapons School's old training buildings on Wyoming Boulevard. In 1971 when DASA was reorganized into the Defense Nuclear Agency (DNA) the museum was transferred to the Atomic Energy Commission, and the DNA instructors would continue to help lead tours at the museum over the years. Today DNWS students and visitors are highly encouraged to visit and see the full size aircraft and displays at the National Museum of Nuclear Science & History at its current location in Albuquerque at 601 Eubank Boulevard SE.

In 1955, local Albuquerque newspapers ran articles about the 'nuclear U' which was followed by an August 1956 Popular Mechanics article titled, 'Privates and Generals Study A-Bomb.' The photos of the classroom training appear to have been provided by the school or Field Command Defense Atomic Support Agency. Photos inside the secretive, windowless building were rare in the early atomic program. This school building built in 1953, was nicknamed the 'Kremlin' by students because of the thick layers of security to get inside. By 1971 the school had grown to encompass most of the south end of Wyoming Boulevard in several new buildings. While the Defense Nuclear Weapons School still uses the 1953 'Kremlin' today, other buildings have shifted over to the Air Force and today house the 377th Air Base Wing Headquarters, the Base Civil Engineers and the Base Education Center.

The Armed Forces Special Weapons Project first started training weapons technicians and responders here at the Technical Training Group on Sandia Base in January 1947. This original certificate presented to Navy Lieutenant Alvin Thomas was for completing the Weaponeer Training Course 9 August through 7 October 1949.

In 1955 the local Albuquerque newspapers featured articles about the Armed Forces Special Weapons Projects school popularly known as the Nuclear "U". In August 1956, Popular Mechanics featured an article about the school which had just moved into its current location in 1953. The school's high security windowless building was nicknamed the "Kremlin" by students.

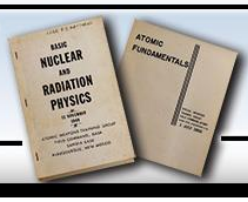
1971 Nuclear Weapons School Catalog.

1981 Draft of the Nuclear weapons Accident Response Procedure manual or NARP.

1976 Interservice Nuclear Weapons School Basic Nuclear Physics text book.

1998 Defense Nuclear Weapons School Catalog.

1960 Atomic Weapons Training Group Basic Nuclear and Radiation Physics text book.



1958 Special Weapons Training Group Atomic Fundamentals Primer.

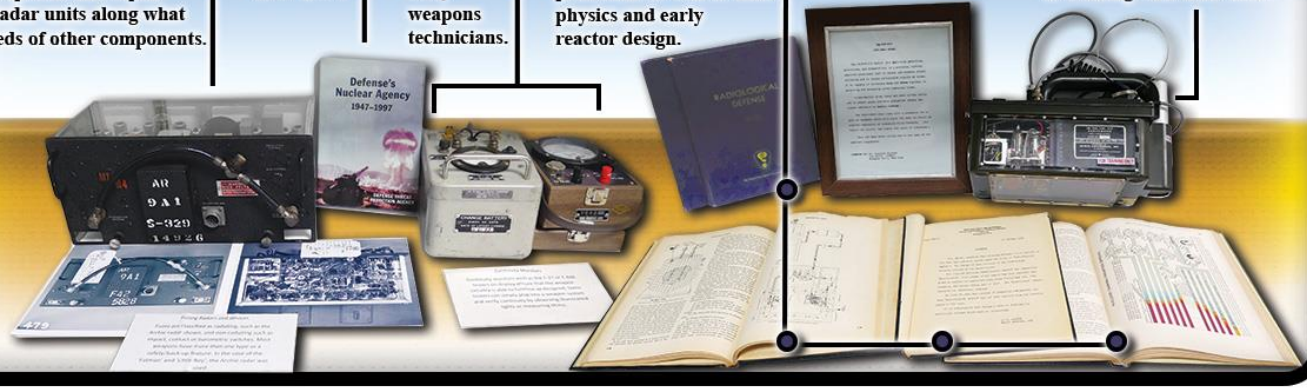
AN/APS-13 (SCR 718) Radar used with early atomic bombs. Students at the Technical Training Group had to learn how to operate and repair these radar units along what hundreds of other components.

Early history of DTRA from 1947-1997.

Continuity monitors used by early weapons technicians.

A four volume set of text books published by the Armed Forces Special Weapons Project which cover nuclear weapons effects, radiation monitoring and force protection as well as basic physics and early reactor design.

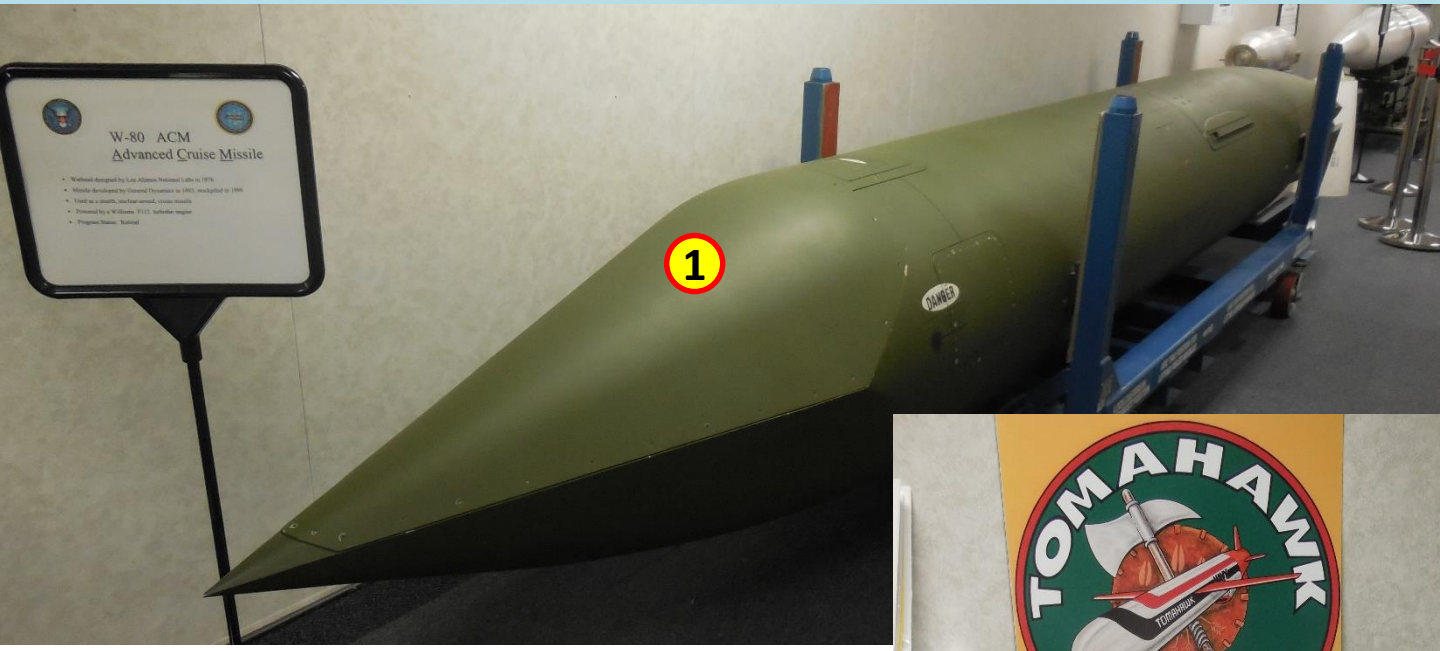
This AN/PDR-27C is a 1950's era detector modified for use in training with clear sides.



U.S. Missile & Rocket Hallway (Air Force) - Continued

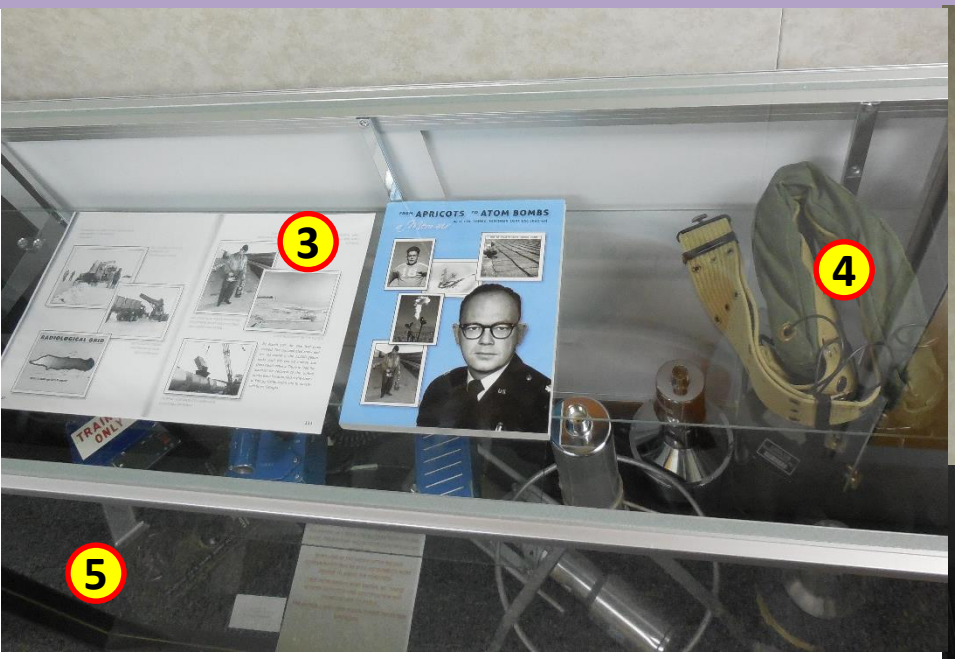
- Air Force Missiles and Rockets
  1. Short Range Attack Missile (SRAM) or “rubber rocket” was a stand off weapon which was carried on B-52 wing pylons or in 8 round rotary cells in the bomb bay.
  2. Here is a model of B-1 bomber with rotary launcher cells for the SRAM.
  3. The SRAM was retired after the Cold War, here you can feel the silicone rubber ablative skin of the missile. (encourage tour to touch this portion of the display)

U.S. Missile & Rocket Hallway (Air Force) - Continued



- Air Force Missiles and Rockets
  1. The Advanced Cruise Missile or ACM was a stealthier version of the Air Launched Cruise Missile or ALCM. These missiles were retired in 2012 but are more infamous for the 2007 “Minot to Barksdale” incident where 6 of these ACM’s were transported across the country accidently with live nuclear warheads.
  2. Here is a W80-1 thermonuclear warhead that would be bolted into the Air Force’s ACM or ALCM. You can see how small these kiloton range thermonuclear warheads are now compared to the Fat Man from the Manhattan Project.
  3. The Tomahawk was the Navy’s cruise missile and it used the W80-0 variant of the W80 warhead.

Detector Hallway – Thule/Taschner & the FIDLER

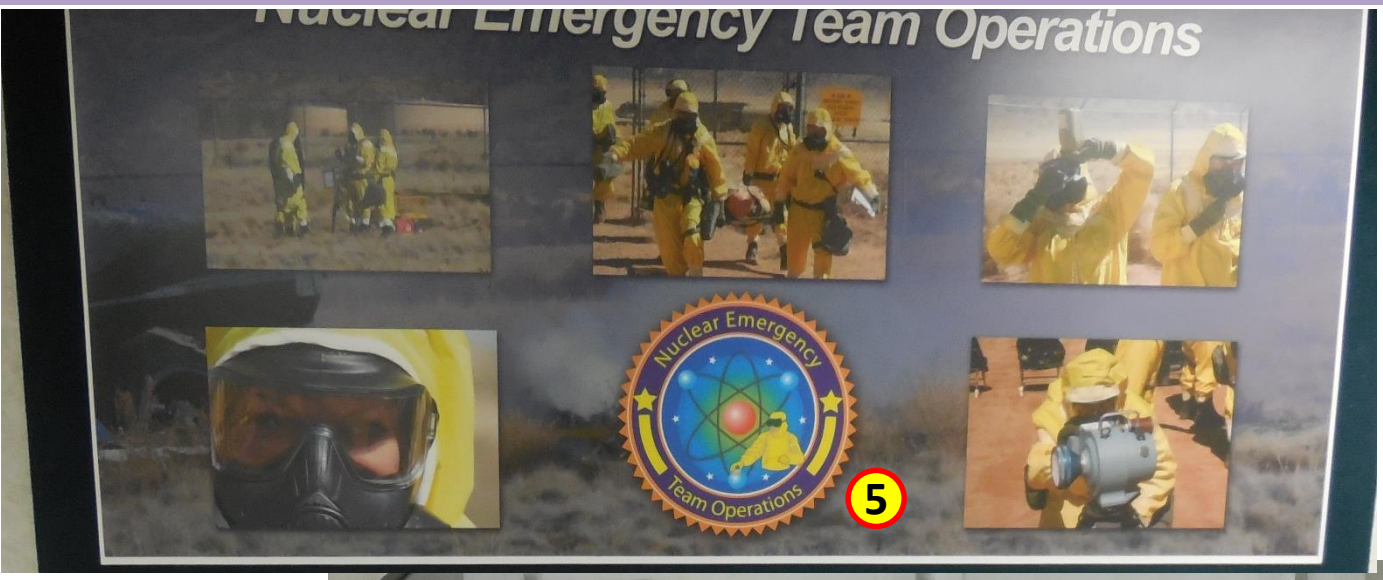


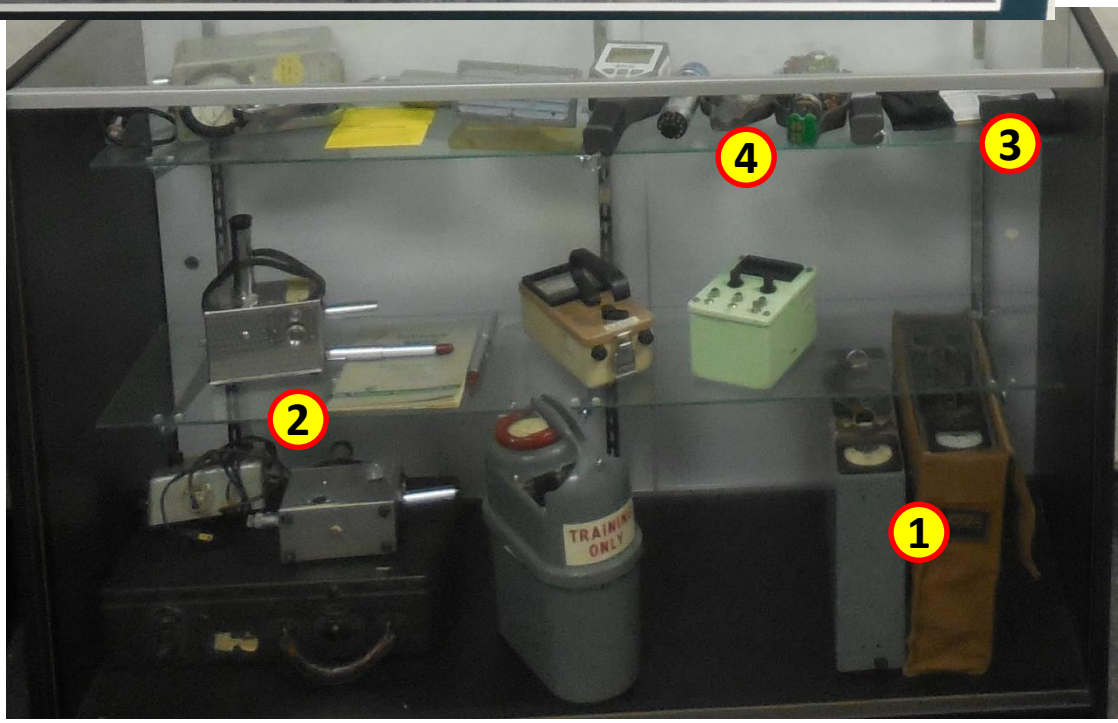
1. The Defense Atomic Support Agency was part of all 32 serious nuclear weapons accidents and this plaque is from the 1968 Thule Greenland accident where a B-52 crashed into the ice 700 miles north of the Artic circle.
2. The weapons in the Thule Greenland accident were destroyed scattering plutonium contamination across the ice. Since alpha particles are blocked almost anything including ice and water, it made it very difficult to detect the contamination. Newly developed Field Instrument for the Detection of Low Energy Radiation (FIDLER) detectors were used to detect faint X-ray emissions associated with alpha decay with SNM.
3. In this picture here, Air Force Health Physicist Major John Taschner uses a FIDLER probe. John Taschner, a veteran of the Palomares and Thule crash response was a frequent guest lecturer at the DNWS. He passed away in September 2016.
4. This battery belt was used by Maj Taschner at Thule, they had to keep their batteries under their parkas to keep them from dying in the cold. Cords also snapped in the frigid temperatures.
5. While Thule responders mostly used FIDLER and PDR-27 detectors, here is an example of the first standardized military detector, the AN/PDR-1, this type of detector would have been used in Operation SANDSTONE.

Detector Hallway – Military Detectors & Neutron Meters

1. Original training AN/PDR-27C training detector modified with cutaways. The AN/PDR-27 was a used widely in the 50's and 60's.
2. The Services developed their own detectors in the 70's and 80's, the AN/VDR-2 was widely used by the Army and Marine Corps. (Shelf broken, detectors not currently on display)
3. The PDQ-1 was the Navy developed detector, Navy and Marine Corps personnel were seen using these in Operation TOMODACHI with pancake Geiger-Mueller probes to look for contamination from the Fukushima reactor accident. (Shelf broken, detectors not currently on display)
4. This is a Canberra Dover GPS trainer which replicates a standard Army/Marine Corps AN/PDR-77 detector. The blue capped wires are for GPS connections and a simulated contamination field is programmed into the detector probes. GPS accuracy is poor but it offers a training solution when real sources or simulated contamination is not available.
5. This Eberline detector, this is a neutron detector that can measure neutron exposure by using a polyethylene ball around a BF3 proportional counter. These are often called "REM Balls" and the plastic slows the neutrons just like a human body would so they can accurately measure exposure by neutrons.
6. T-290 portable air sampler from the 1960's-90's, detects minute amounts of airborne tritium.
7. Detector types and evolution posters.
8. Poster of the 32 serious nuclear weapons accidents covering a period from 1950 to 1980. Of these serious accidents, 3 were Navy, 1 was with DOE and the other 28 were Air Force. Some involved the spread of contamination and proper response and clean up procedures were continuously evolved based on these lessons learned.

Detector Hallway – Commercial Off the Shelf Technology (COTS)





1. Cabinet of civilian detectors, these early 1940's scintilometer and Geiger Mueller were from the early days at Los Alamos. Donated by Dr. Glen McDuff.
2. A Victoreen Condensation Chamber, one of the earliest personal dosimeters used widely in medical applications, this ion chamber and heavy reader unit was used in the early Manhattan Project to measure radiation outputs from early cyclotrons. Donated by Dr. Glen McDuff.
3. The Pager-S or "radiation pager" was first developed in the 1990's and provided a simple qualitive read out from 0-9. These were widely issued after the September 11th attacks in the fear of terrorist radiological or nuclear weapons.
4. The IdentiFINDER is widely issued to military units and National Guard Civil Support Teams today. It provides search and identification capabilities with a host of technologies. Here at the school we teach about the different scintillators, here are two different types (LaBr & NaI) attached to their PMT's, if you look you can also see the He3 tube for neutron detection.
5. DNWS has taught radiological force protection and nuclear accident response from its beginnings in 1947. NETOPS is one of the premier courses and the only DOD course with access to actual contamination training fields.

Detector Hallway - Civil Defense

1. Civil Defense posters and ads from the U.S. to educate and prepare for a possible nuclear war.
2. Civil Defense posters were also widely distributed in the U.S.S.R.
3. Since World War II, Civil Defense was a function of the DOD to protect the U.S. population in case of war. Helmets and armband donated by Matt Thompson.
4. Fall out shelters were distributed through cities and towns, stocked with supplies. Plans for building your own backyard shelters were also widely distributed.
5. A selection of various types of detectors issued to shelters or Civil Defense teams. These include Geiger Mueller detectors as well as ion chambers, this opened detector is an ion chamber. Detectors donated by Dr. Glen McDuff and Matt Thompson.
6. Civil Defense identification and reference cards. Donated by Dr. Glen McDuff.
7. A Sears Roebuck dosimeter kit sold during the height of the Cold War. Donated by Dr. Glen McDuff.
8. In 1979, authority for Civil Defense transferred to the newly established Federal Emergency Management Agency (FEMA) after the Three Mile Island reactor accident. The same detector training manuals issued by the Department of Defense and then FEMA. Donated by Matt Thompson.

Detector Hallway - Dosimeters

1. This cabinet is a collection of tools used to monitor individual dosimetry or radiation exposure, some of the earliest types still widely used are film badges which are read by developing the film which is sensitive to radiation.
2. Personnel actively working with radiological materials may wear multiple dosimeters. Ring dosimeters measure exposure to hands if the worker is actually handling radioactive materials on a regular basis.
3. Pen dosimeters come in many forms including the IM-93 still issued to some programs are ion chambers, a quartz filament acts as the anode and a charger resets the potential and this is what read when you look through it. It provides immediate feedback but a shock or hard bump can throw off the reading.
4. Thermo-luminescent dosimeters (TLDs) also known as chip dosimeters capture energetic electrons caused by ionizing radiation. Heating these causes luminescence which can be read to give an exposure.
5. The EIR3 was a chemical dosimeter issued to Army tactical units in the 1950's and ionizing radiation caused a chemical reaction which would change the color of the fluid depending on the amount of exposure.
6. The IM-108 and IM-174 were personal dosimeters were actually ion chamber survey meters for measuring exposure rates.
7. Today the trend is toward Electronic Personal Dosimeters (EPD's) these record dose and provide exposure rates at a glance. Not all of these are approved for a "legal dose of record" which requires specific calibration. NCRP guidance today states that first responders without some type of actively readable exposure monitoring device an EPD is considered "unprotected public" and may not go into a radiation area in an emergency.

Airplanes/Technology & Fuel Cycle Hallway – Technology

1. (U) 1957, the world's first ICBM, Russia's R-7 is tested sending the first satellite into orbit, Sputnik.
2. (U) 1947, William Shockley, John Bardeen and Walter Brattain develop and patent the first transistor at Bell Labs. Bell Labs were the prime contractor for development of the Nike missiles.
3. (U) The evolution from vacuum tubes to the transistor to early integrated circuits. Miniaturized, rugged and robust solid state electronics made supersonic jets, missile guidance and robust weapons circuitry possible.
4. (U) Early calculators were large, cumbersome systems with limited capabilities. Here is an ad for an early University type of calculator featuring William Shockley.
5. (U) Cold War defense research drove the huge surge in technology which we are still benefitting from today. The birth of Silicon Valley owe everything to defense spending as noted in the PBS American Experience documentary, Silicon Valley. In 1965, fully 70% of all integrated circuits produced by silicon valley went to defense applications.
6. (U) DOD version of an Intel 8080 microprocessor, the first affordable ($375 in 1974) 8-bit microprocessor which made personal computers possible.
7. (U) Sandia produced integrated circuits. Sandia National Labs pioneered the concept of the "hyper-clean room" which is the standard now used not only in IC manufacturing but also in surgical suites. SNL still produces their integrated circuits today.

Airplanes/Technology & Fuel Cycle Hallway – Technology

1. (U) A B-29 Silver-plate vacuum tube radio transmitter, the receiver was a separate unit. A transmitter like this was located at the B-29 crash site on Manzano.
2. (U) A commercial off the shelf, vacuum tube test unit used for early weapons system maintainence.
3. (U) A 1946 vacuum tube "beach radio," this is the smallest commercial vacuum tube radios could get.
4. (U) Examples of early transistor radios, smaller and cheaper than their vacuum tube cousins.
5. (U) Another desk top calculator advertisement. This one featuring the Russians marveling at an American calculator.
6. (U) The January 1975 cover of Popular Electronics which featured an Altair personal computer on the cover. Bill Gates and Paul Allen left Harvard to go to Albuquerque because of this magazine article.
7. (U) Air Force Weapons Lab (AFWL) engineers Ed Roberts and 1st Lt Forest Mimms founded Micro Instrumentation and Telemetry Systems (MITS) to sell small circuit kits for model rocket kits in Albuquerque. Very soon MITS was selling personal calculator kits and with the release of the Intel 8080 chip in 1974 they began selling Altair personal computer kits out of Ed Roberts garage in Albuquerque, two years before Apple was formed. Bill Gates and Paul Allen sold Ed Roberts Basic software to program these early Altair computers and they formed Microsoft on 4 April 1975 in Albuquerque. The mugshot is from Bill Gates getting pulled over by APD in 1977 for speeding in a Porsche.
8. (U) One of many electronics "how to manuals" published by Forest Mimms and sold through Radioshack.

Airplanes/Technology & Fuel Cycle Hallway – Technology

1. Here is an overview of the uranium fuel cycle from mining, milling, conversion and enrichment to its uses in industry, medicine, reactors and weapons.
2. Here are samples of natural uranium ore similar to the ore mined here in New Mexico.
3. The Atomic Energy Commission encouraged Americans to prospect for uranium and the AEC would then buy the claims to make sure we had enough of this strategic material. Donated by Matt Thompson.
4. This field assay kit would compare field samples to find concentrations of uranium.
5. The natural uranium was then milled and converted into various oxides shown here, not shown is uranium hexafluoride which was the gas used for enrichment.
6. Low enriched, 3%-5% enriched, would be mixed into ceramic fuel pellets to use in light water power reactors.
7. The by product of enrichment is depleted uranium, a few small oxidized pieces are shown here.
   Q: Which is more hazardous, natural uranium or depleted uranium?
   A: Natural uranium is 60% more radioactive than depleted uranium, as natural still contains U-234 and U-235. Both are considered heavy metals and have similar chemical toxicity with 50-150 milligrams enough to kill an adult. The reason so many people here horror stories about depleted uranium is Iraqi sponsored propaganda after the first Gulf War. DU tank penetrators were so effective they started a disinformation campaign which persists to this day despite IAEA and WHO reports to the contrary.
8. Deuterium or heavy water and the compass has small vials of tritium which glows, both are isotopes of hydrogen.

Airplanes/Technology & Fuel Cycle Hallway – Technology

1. This is the outer casing of a centrifuge, similar to the ones widely proliferated by AQ Khan.
2. Centrifuge enrichment technology wasn't perfected until around 1947. Cascades of centrifuges would spin uranium hexafluoride gas at very high speeds causing the physical separation of isotopes of uranium with centrifugal force pulling heavier isotopes of U-238 to the outside and lighter isotopes of U-235 would be on the inner side. The third line was for the feed gas into the centrifuge. These different types of centrifuges in Iran have cooling lines running around the outside to increase efficiency.

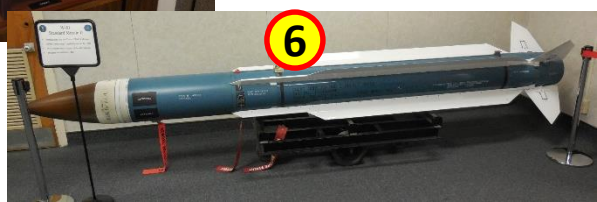
Q: Where is the largest uranium enrichment facility in the world?

A: Eunice, NM. URENCO enriches uranium in huge cascades of 40 foot tall centrifuges to 3%-5% for use in commercial reactor fuel.

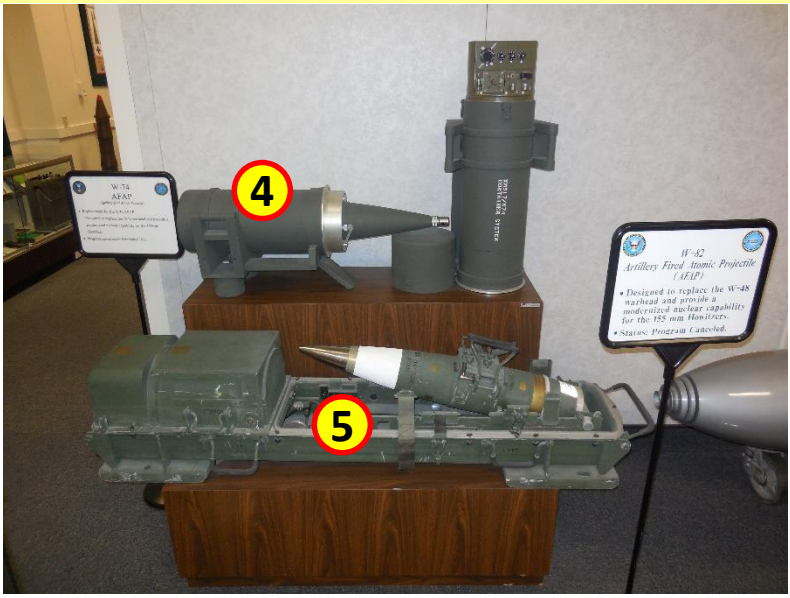
3. These AT-400R Fissile Material Containers are made to Type B shipping configurations and were intended to carry Russian plutonium ~4 kg or HEU ~ 8 kg to safe from across the former Soviet Union to newly designed and built safe/secure storage as part of DTRA's Cooperative Threat Reduction program. The drums were designed by Sandia National Labs and built by Westinghouse Corporation. Each weighs 160 lbs. empty and 26,456 were delivered.
4. CANDU fuel bundle, actual size and weight.
5. Canadian Deuterium (CANDU) reactors use automatic loaders and can burn natural uranium since they use heavy water as a moderator. These types of reactors allowed India to extract plutonium for their nuclear program.
6. This is a small portion of an actual light water reactor fuel assembly, the full assemblies are 10-12 feet long and weigh over a thousand pounds.
7. These light water fuel assemblies can be used in Boiling Water Reactors (BWRs) or Pressurized Water reactors (PWRs). Fuel assembly configurations differ widely depending on the reactor design.

Weapons That Never Were

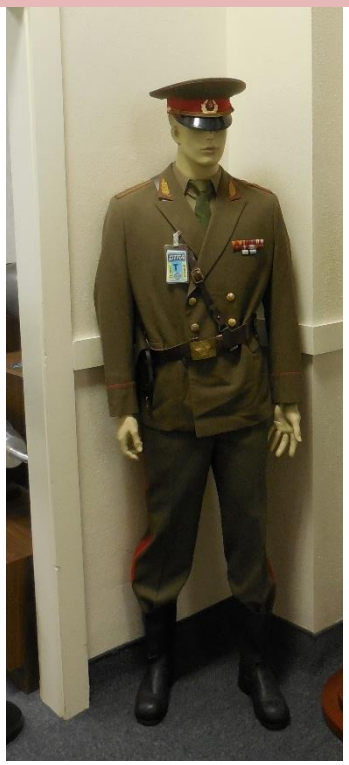
- Weapons That Never Were (this page and next)
  1. Midget-man road mobile ICBM, one solution to missile basing looked at in the 1980's.
  2. W-61 early prototypes for earth penetrating nuclear weapons
  3. B-90 Nuclear Depth Bomb, would have been the newest antisubmarine weapon but cancelled at the end of the Cold War.
  4. W-74 was an improved 155mm nuclear artillery round cancelled in 1973 because of cost.
  5. W-82 was an advanced 155mm nuclear artillery round cancelled at the end of the Cold War by a unilateral decision by President H.W. Bush
  6. W-81, the Tarter, Talos and Terrier missiles were all "standardized" in to the new standard missile, the W-81 would have been its nuclear warhead option. By the end of the Cold War, needing presidential release authority for nuclear air defense when facing conventional Silk Worm anti-ship missiles didn't seem efficient. Advent of the highly advanced AEGIS radar system also meant that conventional options would work fine.
  7. W-89 SRAM II and SRAM-T, smaller tactical stand-off nuclear attack missiles similar to the Short Range Attack Missile but these could have been carried by F-15's. Cancelled at the end of the Cold War.



Weapons That Never Were



Foreign Missile Hallway



- Ivan the KGB LTC, the mannequin is wearing a Soviet KGB LTC's uniform and would stand guard at the entrance to the foreign missile hallway. (the boots & belt are Soviet enlisted uniform items)

- Foreign Missile Hallway, the foreign missile hallway has an extensive collection of foreign missile models that are all 1/10th scale (point to a 7.25" figure).
  1. The silver missile is the North Korean Nodong missile, this missile is widely proliferated and also used by Pakistan and Iran.
  2. The cabinet has missile sections taken during Cooperative Threat Reduction trips where U.S. and Russian teams dismantled thousands of weapon systems.
  3. Also in the cabinet is a wide collection of Soviet/Russian oscilloscopes, meters and a Soviet era calculator. These items along with an extensive collection of overdue library books from the I.V. Kurchatov Institute of Atomic Energy were donated by Dr. Glen McDuff when he was in the Soviet Union to help secure the purchase of two Topaz II reactors.
  4. The green and red or black missiles are several Soviet/Russian missiles with their NATO designations, SS for Surface to Surface, SS-N for Surface to Surface Naval and SSX for experimental.
  5. The cabinet at the end of the hallway has several smaller models including a MIG-15 and an Il-28 Beagle bomber, both of which were in Cuba during the October 1962 missile crisis. The MRBM and IRBM's involved in that crisis were the SS-4 Sandal and the SS-5 Skean which are across from that cabinet.
  6. The white and tan missiles are a few of China's missile systems with the NATO designation, CSS or Chinese Surface to Surface. China names most of their missiles DF or Dong Feng for East Wind.
  7. The white and black missiles are French systems, today France only maintains the M-51 SLBM and the ASMP air launched missile having retired their ground systems and moving to a strategic dyad.

Foreign Missile Hallway

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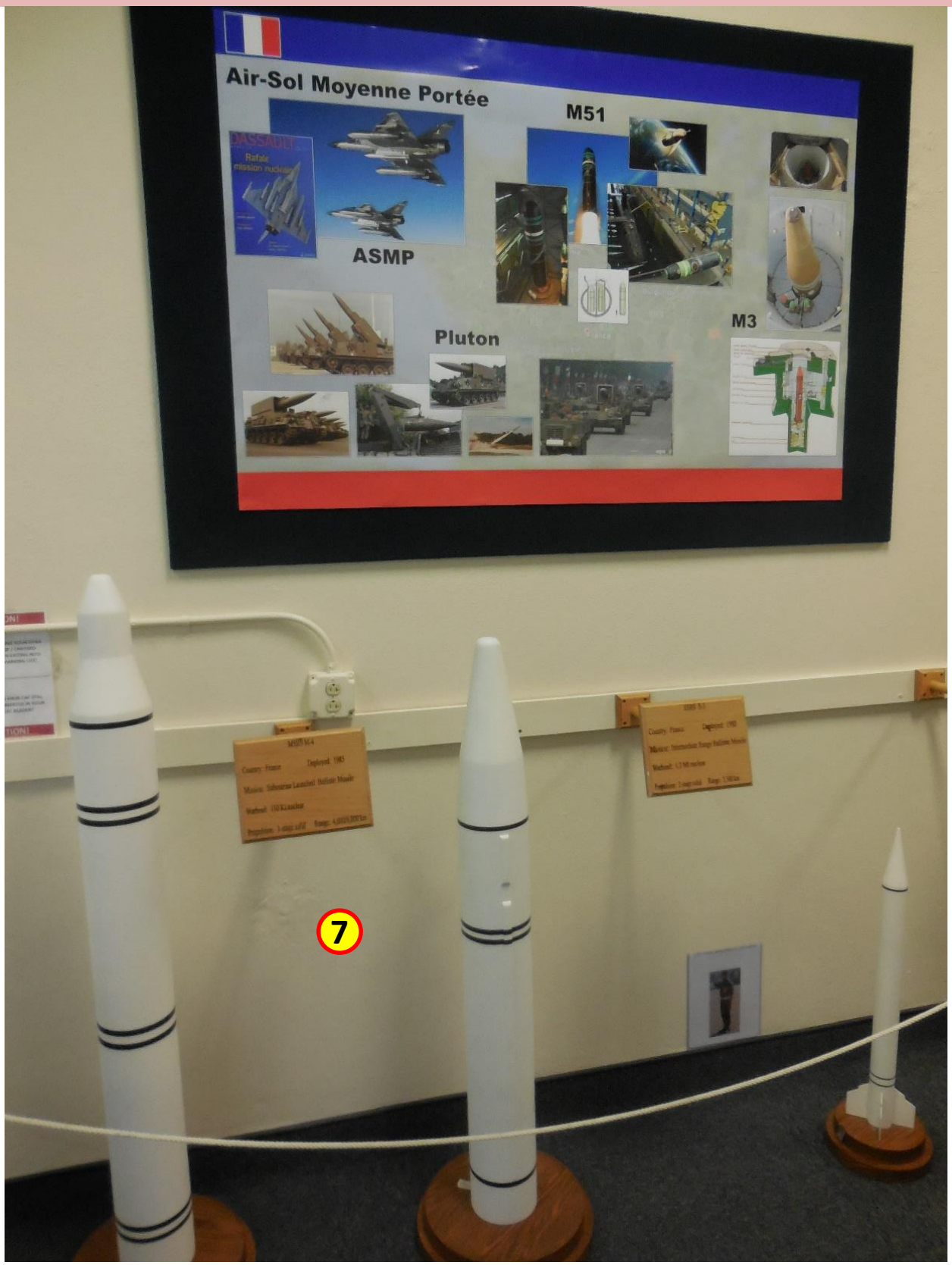
Also in the cabinet is a model, patch and commemorative medal from the K-141 Kursk. The Kursk was an Oscar class cruise missile submarine that carried 24 SS-N-19/P-700 Granit Cruise missiles.

Foreign Missile Hallway

6. The white and tan missiles are a few of China's missile systems with the NATO designation, CSS or Chinese Surface to Surface. China names most of their missiles DF or Dong Feng for East Wind. In the last decade, the Chinese have introduced a brand new ICBM, the DF-41.

Foreign Missile Hallway



7. The white and black missiles are French systems, shown here are the M4 SLBM, the M3 IRBM and the Pluton tactical nuclear rocket. Today France only maintains the M-51 SLBM and the ASMP air launched missile having retired their ground systems and moving to a strategic dyad.

Commandant's Hallway

- Pictured here are the 30 DNWS Commandants over the last 70 years.
  1. The first Commandant, LTC John Ord established the Army's Radar School in Florida during WWII, hand picked by MG Groves in 1946 as one of the Sandia Pioneers and the only one with advanced degrees, LTC Ord was tasked with establishing the Technical Training Group to train atomic weapons and radiological response technicians. Col Ord then went on to establish Army Research & Development.
  2. The first Air Force Commandant was Lt Col Byfield "Flash" Gordon. A combat aviator from WWII, Korea and Vietnam, he commanded a B-24 out of Libya on the Ploesti Oilfield mission of WWII. Originally, Lt Col Gordon was sent to the Nuclear Weapons School in 1972 on a two month TDY to close the school down and take whatever he could back to the museum and Air Force weapons technician school at Lowry AFB in Colorado. The Department of Defense insisted that the NWS museum remained intact and that if the Air Force wanted to move the school from KAFB they would have to take the entire museum as well as thorium seeded training fields. With no budget for that size of a move, Lt Col Gordon became the Inter-service Nuclear Weapons School commandant from 1972-76.